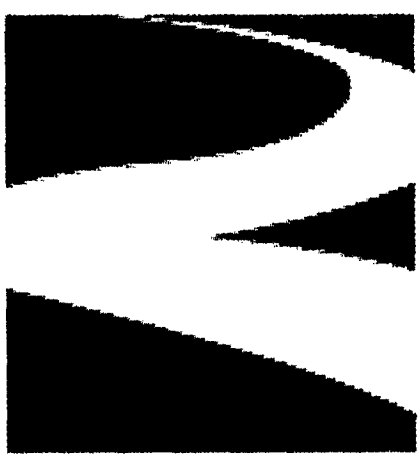
CALFED STORAGE AND CONVEYANCE COMPONENTS

FACILITY DESCRIPTIONS AND COST ESTIMATES

VOLUME 3 OF 3



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PROGRAM

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CALFED STORAGE AND CONVEYANCE COMPONENT FACILITY DESCRIPTION AND COST ESTIMATE REPORTS

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FACILITY DESCRIPTIONS AND UPDATED COST ESTIMATES FOR THE CHAIN OF LAKES PROJECT

Prepared by the CALFED Storage and Conveyance Refinement Team
October 1997

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INTRODUCTION

The *Facility Descriptions and Updated Cost Estimates for the Chain of Lakes Project* has been prepared as part of the Storage and Conveyance Component Refinement Task of the CALFED Bay-Delta Program (CALFED or Program). CALFED's mission is to develop a long-term comprehensive plan that will restore the ecological health and improve water management for beneficial uses of the San Francisco Bay/Sacramento-San Joaquin Delta (Bay-Delta) system.

This report summarizes the principal features, estimated costs, and environmental considerations of the Chain of Lakes Project. This project would function as a combined isolated storage and conveyance facility to transfer Sacramento River flows across the Sacramento-San Joaquin Delta (Delta) to Clifton Court Forebay. A chain of seven lakes, created by flooding existing Delta islands, would be connected by siphons. Two alternative configurations have been evaluated: the Siphon Only Alternative, which relies on gravity to transfer water between island storage facilities, and the Siphon and Pump Alternative, which supplements the conveyance capacity between island storage facilities with pumping plants. The general location of the Chain of Lakes Project is shown on Figure 1.

This evaluation and others being performed by CALFED are intended to provide facility descriptions and cost estimates of representative storage and conveyance components. The objectives of the Chain of Lakes Project evaluation are to (1) provide a cost estimate for the project that represents costs within the range expected if the project were to be constructed today and (2) enable CALFED to compare this project against other projects that might be considered as part of a long-term CALFED solution strategy.

The Chain of Lakes is a relatively new concept and has not been previously studied in detail; thus, the cost estimates for the Chain of Lakes Project were developed primarily by Bookman-Edmonston Engineering and CALFED staff. The present cost estimate was aided, however, with quantities for similar facilities presented in previous reports including the 1990 California

Department of Water Resources (DWR) report titled *North Delta Program Draft EIR/EIS* and the 1995 DWR report titled *Isolated Transfer Facility Cost Estimate*.

A preliminary evaluation of the environmental considerations associated with the Chain of Lakes Project is also included in this report. Fish, wildlife, plant, and cultural resources that could be affected have been described and potential impacts have been identified. The information for the evaluation of environmental considerations was gathered from existing literature and databases.

PROJECT BACKGROUND

Reclamation of Delta marshlands began in the 1850s, and by the 1930s, nearly all of the Delta had been reclaimed into intensively farmed islands. Since then, there have been numerous studies on salinity intrusion control, water quality improvement, and overall management of the water resources in the Delta (including various water storage and conveyance concepts).

The Chain of Lakes Project is a relatively new water storage and conveyance concept that would help improve the management of water resources in and through the Delta. Over the past several years, several studies have been completed for similar concepts that flood Delta islands to provide water storage. However, a review of DWR and the U.S. Bureau of Reclamation (Reclamation) libraries and publications revealed no previous investigations of the "Chain of Lakes Project."

The Chain of Lakes Project concept was identified in a March 1997 CALFED technical studies report titled *Status Reports on Technical Studies for the Storage and Conveyance Refinement Process* and in the February 1997 *Preliminary Working Draft CALFED Bay-Delta Program Storage and Conveyance Component Inventories*. The present evaluation of the Chain of Lakes Project provides a more detailed cost estimate, review of engineering issues, and potential resources impacts than any of the previous documents. This evaluation will enable the Chain of

Lakes Project to be compared to other projects for consideration as part of a long-term CALFED solution strategy.

FACILITIES DESCRIPTION

This section provides an overview of the major features included in the proposed Chain of Lakes Project. The preliminary layout of the Chain of Lakes Project is based on original work developed by Bookman-Edmonston Engineering and CALFED staff.

PROJECT LOCATION

The Chain of Lakes Project would be located in the Delta in Sacramento and San Joaquin Counties (see Figure 1). Figure 2 provides a detailed location map of the Chain of Lakes Project and shows the locations of all major facilities associated with the project.

PROJECT DESCRIPTION

The Chain of Lakes Project is a combined isolated storage and conveyance facility that would transfer Sacramento River flows across the Delta to Clifton Court Forebay for export through State Water Project (SWP) and Central Valley Project (CVP) Delta pumping facilities. A chain of seven Delta islands would be connected by siphons crossing existing Delta channels. These "island-lakes" would include Tyler Island at the head end of the chain, followed in succession by Bouldin, Venice, Mandeville, Bacon, Woodward, and Victoria Islands. Victoria Island would be connected to Clifton Court Forebay. The Chain of Lakes Project would, in effect, move the Delta export location from Clifton Court Forebay to the lower Sacramento River at the Delta Cross Channel.

Flows from the Sacramento River would be diverted through an enlarged Delta Cross Channel into the Chain of Lakes. The Delta Cross Channel gates would be enlarged to a total width of

300 feet and would include two new radial gates constructed to accommodate an inflow capacity of 10,000 cubic foot per second (cfs). Water entering the Chain of Lakes would flow through fish screens constructed downstream of the radial gates. A low lift pump station would be located downstream of the fish screen to control the hydraulic performance of the fish screens and to lift the water into a new 500-foot-wide open channel leading to Tyler Island.

Islands in the Chain of Lakes system would be hydraulically connected by siphons. One of the key design considerations is minimizing the number and size of siphons required to carry the design flow of 15,000 cfs within the constraint of the maximum hydraulic gradient available between the upstream end of the system at Tyler Island and the downstream end of the system at Clifton Court Forebay. The 15,000 cfs total conveyance capacity would be met through the diversion from the Sacramento River and from intake pumping stations located on each of the island-storage facilities. The maximum upstream water surface elevation at Tyler Island could not exceed 4.0 feet above mean sea level (MSL) for safety considerations related to levee stability and the requirements of DWR's Division of Safety of Dams. The minimum water surface elevation at the most downstream end of the system at Clifton Court Forebay could not fall below 2.0 feet below MSL because of potential export pump cavitation problems. The result is a maximum total allowable hydraulic gradient of 6.0 feet from Tyler Island to Clifton Court Forebay.

Two alternatives were identified for this evaluation: a Siphon Only Alternative and a Siphon and Pump Alternative. Figures 3 and 4 illustrate maximum storage capacities of the islands during storage operations and during maximum conveyance operations of 15,000 cfs for the Siphon Only Alternative and the Siphon and Pump Alternative, respectively. Because the Chain of Lakes concept is fairly new and has not previously been studied in detail, further hydraulic analyses and studies are required to verify the size and number of siphons required for this project.

The Siphon Only Alternative, shown in Figure 3, relies entirely on gravity flow under the available hydraulic gradient to convey the design flow of 15,000 cfs. The Siphon and Pump Alternative, shown in Figure 4, incorporates low lift pumping plants to supplement the capacity of the siphons as well as to reduce the size and number of siphons required to convey 15,000 cfs through the system. For both the Siphon Only Alternative and the Siphon and Pump Alternative, 5,000 cfs intake pumping stations with fish screens would be located on each island to supplement filling the storage capacity of the islands and to meet the conveyance capacity of the system.

PRINCIPAL FACILITIES

This section provides an overview of the major features of the Chain of Lakes Project. Generally, the principal facilities include an enlarged Delta Cross Channel with fish screens; isolated island storage and conveyance facilities on Tyler, Bouldin, Venice, Mandeville, Bacon, Woodward, and Victoria Islands; a siphon connection between all the islands; intake pumping stations with fish screens on all islands; and a siphon connection to Clifton Court Forebay. Both alternatives of the Chain of Lakes Project would include a new screened interconnection from Clifton Court Forebay to the lower Delta-Mendota Canal to facilitate transferring water from the Chain of Lakes Project system and Clifton Court Forebay to the Tracy Pumping Plant. Table 1 provides a summary of the physical characteristics of each of the major features associated with each alternative.

Enlarged Delta Cross Channel

The enlarged Delta Cross Channel would consist of an enlarged gate structure; a new 500-foot-wide open channel to Tyler Island; a multiple folded "V" fish screen and bypass system; an 11-unit, 16,610 horsepower pump station with a capacity of 10,000 cfs; and associated works such as a control building, parking, access, lighting, and fencing.

The configuration of the intake facility for the Chain of Lakes Project would include a 10,000 cfs diversion from the Sacramento River through an enlarged Delta Cross Channel. The total conveyance capacity of the Chain of Lakes Project is designed to be 15,000 cfs. The additional 5,000 cfs would be provided by the intake pumping stations located on each of the islands making up the Chain of Lakes Project.

Tyler Island

Tyler Island would be the most upstream storage/conveyance component of the Chain of Lakes Project. The island would be converted from its current land use, which is primarily agricultural, to a storage facility with an inlet from the Delta Cross Channel and a siphon outlet to Bouldin Island. The maximum storage capacity of Tyler Island would be 167,960 acre-feet at a water surface elevation of 4.0 feet above MSL requiring approximately 23 miles of reinforced levees. Tyler Island would also include a screened intake pumping station from the Mokelumne River with a capacity of 5,000 cfs.

Under the Siphon Only Alternative, Tyler Island would be connected to Bouldin Island via three 30' x 30' x 1,100' concrete box siphons under the Mokelumne River. To convey 15,000 cfs through the length of the Chain of Lakes system under the Siphon Only Alternative, Tyler Island would be maintained at a water surface elevation of 4.0 feet above MSL to provide the necessary system hydraulic gradient.

Under the Siphon and Pump Alternative, water would flow via gravity from Tyler Island to Bouldin Island. To convey 15,000 cfs from Tyler Island to Bouldin Island, a head difference of at least 5.8 feet would be required between the two islands. The siphon connection to Bouldin Island would consist of two 23' x 23' x 1,100' concrete boxes.

Bouldin Island

Bouldin Island would have a maximum storage capacity of 171,070 acre-feet at a maximum water surface elevation of 4.0 feet above MSL. Approximately 18 miles of levee would have to be reinforced to accommodate storage on the island's interior. Bouldin Island would be connected to Tyler Island upstream and to Venice Island downstream. Additionally, a screened intake pumping station from the South Fork Mokelumne River would be included on the island's northern levee.

Under the Siphon Only Alternative, Bouldin Island would have to maintain a water surface elevation of about 3.2 feet above MSL to provide the necessary hydraulic gradient to convey 15,000 cfs through the entire Chain of Lakes system. At this water surface elevation, Bouldin Island would have a storage capacity of 162,470 acre-feet. This would create a head difference of about 0.8 feet between Tyler and Bouldin Islands. Bouldin Island would be connected to Venice Island via three 30' x 30' x 700' concrete box siphons beneath Potato Slough.

Under the Siphon and Pump Alternative, the siphon between Bouldin and Venice Islands would be supplemented by a 15,000 cfs pumping plant. To convey 15,000 cfs from Tyler to Bouldin Island, the water surface elevation would have to be maintained at 1.8 feet below MSL, which would correspond to a storage volume of 117,270 acre-feet. The pumping plant would be an indoor type, housing 11 pumping units, including one standby unit, and would have a total of 25,080 horsepower.

Venice Island

Venice Island would have a maximum storage capacity of 86,490 acre-feet at a maximum water surface elevation of 4.0 feet above MSL. Approximately 12 miles of levee would have to be reinforced to accommodate storage on the island's interior. Venice Island would be connected to Bouldin Island upstream and Mandeville Island downstream. The siphon connection between

Venice and Mandeville Islands would be 1,700 feet long beneath the San Joaquin River. Venice Island would also include a screened intake pumping station from the San Joaquin River at the southeast corner of the island.

Under the Siphon Only Alternative, a water surface elevation of 2.4 feet above MSL would have to be maintained in order to provide the hydraulic gradient required to convey 15,000 cfs through the entire Chain of Lakes system. The head difference required between Bouldin and Venice Islands would be approximately 0.8 feet. At this elevation, the storage capacity would be 79,090 acre-feet. The connection to Mandeville Island would be via three concrete box siphons with dimensions of 30' x 30' x 1,700'.

Under the Siphon and Pump Alternative, the water surface elevation on Venice Island could be maintained at the maximum water surface elevation of 4.0 feet above MSL by the pumping plant associated with the siphon between Bouldin and Venice Islands, while conveying 15,000 cfs through the Chain of Lakes system. Water from Venice Island would be conveyed by gravity through two concrete box siphons to Mandeville Island. The dimensions of the two box siphons would be 23' x 23' x 1,700'. No pumping plant would be located on Venice Island.

Mandeville Island

Mandeville Island would have a maximum storage capacity of 121,270 acre-feet at a maximum water surface elevation of 4.0 feet above MSL. Mandeville Island would be connected to Venice Island upstream and Bacon Island downstream. The connection between Mandeville and Bacon Islands would be through a 900-foot siphon beneath Connection Slough. The conversion of Mandeville Island to a storage facility would require the reinforcement of about 14 miles of levees. Mandeville Island would also include a screened intake pumping station with a capacity of 5,000 cfs from the Middle River on the eastern levee of the island.

Under the Siphon Only Alternative, the water surface elevation on Mandeville Island would have to be maintained at 2.4 feet below MSL to provide the necessary hydraulic gradient to convey 15,000 cfs through the siphon between Venice and Mandeville Islands. The storage capacity at this elevation would be 104,270 acre-feet. The head difference created between Venice and Mandeville Islands would be 1.2 feet. The siphon connection to Bacon Island would be via three 30' x 30' x 900' concrete boxes.

Under the Siphon and Pump Alternative, Mandeville Island would have to maintain a water surface elevation of 2.4 feet below MSL to provide the necessary hydraulic gradient to convey 15,000 cfs from Venice Island to Mandeville Island. The siphon connection between Mandeville and Bacon Islands would include a pumping plant to convey water into Bacon Island. The pumping plant would have a capacity of 15,000 cfs and 25,080 horsepower to recover 6.4 feet of head to enable Bacon Island to maintain a maximum water surface elevation of 4.0 feet above MSL. The pumping plant would be an indoor type, housing 11 pumping units, including one standby unit. The siphon connection between Mandeville and Bacon Islands would require two 23' x 23' x 900' concrete box siphons beneath Connection Slough.

Bacon Island

Bacon Island would have a maximum storage capacity of 107,570 acre-feet at a maximum water surface elevation of 4.0 feet above MSL. Bacon Island would be connected to Mandeville Island upstream and Woodward Island downstream. The downstream connection to Woodward Island would require a 1,500-foot siphon crossing of the man-made cut between Bacon and Woodward Islands. Approximately 14 miles of levees would have to be reinforced to accommodate storage on the island's interior. Bacon Island would also include a screened intake pumping station with a capacity of 5,000 cfs from the Middle River on the island's eastern levee.

Under the Siphon Only Alternative, the water surface elevation on Bacon Island would have to be maintained at 0.6 feet above MSL to convey 15,000 cfs through the length of the Chain of

Lakes system. The storage capacity of Bacon Island at this water surface elevation would be 88,470 acre-feet. The required head difference between Mandeville and Bacon Islands would be 0.8 feet, providing a total flow of 15,000 cfs through three concrete box siphons connecting the islands. On the downstream end of Bacon Island, three concrete box siphons with dimensions of 30' x 30' x 1,500' would connect Bacon Island to Woodward Island.

Under the Siphon and Pump Alternative, the water surface elevation of Bacon Island would be maintained at 4.0 feet above MSL by the pumping plant associated with the siphon between Mandeville and Bacon Islands. The connection between Bacon and Woodward Islands downstream would be made through two 23' x 23' x 1,500' concrete box siphons. No pumping plant would be located on Bacon Island.

Woodward Island

Woodward Island would have a maximum storage capacity of 17,270 acre-feet at a maximum water surface elevation of 4.0 feet above MSL. Woodward Island would be connected to Bacon Island upstream and Victoria Island downstream. The downstream connection to Victoria Island would require a 700-foot siphon crossing of Woodward and North Victoria Canals. Woodward Island would also include a screened 5,000 cfs intake pumping station from the Middle River. Approximately 9 miles of levee would have to be reinforced.

Under the Siphon Only Alternative, the water surface elevation of Woodward Island would have to be maintained at 0.3 feet below MSL to convey 15,000 cfs through the length of the Chain of Lakes system. The storage capacity of Woodward Island at this water surface elevation would be 12,270 acre-feet. The required head difference between Bacon and Woodward Islands would be about 0.9 feet to convey 15,000 cfs through the three siphons connecting the islands. At the downstream end of Woodward Island, three concrete box siphons, with dimensions of 30' x 30' x 700', would connect Woodward Island with Victoria Island.

Under the Siphon and Pump Alternative, the water surface elevation at Woodward Island would be maintained at 2.2 feet below MSL to provide the hydraulic gradient necessary to convey 15,000 cfs from Bacon Island to Woodward Island. At the downstream end of Woodward Island, a pumping facility would relift water into Victoria Island through two concrete box siphons with dimensions of 23' x 23' x 700'. The pumping plant would have a capacity of 15,000 cfs and 25,080 horsepower to regain approximately 6.2 feet of head. The pumping plant would be an indoor type, housing 11 pumping units, including one standby unit.

Victoria Island

Victoria Island would be the last island storage facility in the Chain of Lakes Project. Victoria Island would have a maximum storage capacity of 91,370 acre-feet at a maximum water surface elevation of 4.0 feet above MSL. Victoria Island would be connected to Woodward Island upstream and to Clifton Court Forebay downstream. The downstream connection to Clifton Court Forebay would be made through a 14,000-foot siphon system beneath Old River. Approximately 15 miles of levees would have to be reinforced to accommodate water storage on the island's interior. Victoria Island would also have a screened intake pumping station with a capacity of 5,000 cfs from Old River on the island's west side.

Under the Siphon Only Alternative, the water surface elevation would be maintained at about 1.0 feet below MSL when 15,000 cfs is being conveyed through the length of the system. The storage capacity of the island at this water surface elevation would be 60,770 acre-feet. The required head difference created between Woodward and Victoria Islands would be approximately 0.8 feet. The downstream connection to Clifton Court Forebay would be made through three 30' x 30' x 1,400' concrete box siphons that include radial gate control structures at the siphon outlets to Clifton Court Forebay. The head difference between Victoria Island and Clifton Court Forebay when 15,000 cfs is being conveyed through the system would be 0.9 feet (Clifton Court Forebay water surface elevation at 1.9 feet below MSL).

Under the Siphon and Pump Alternative, the water surface elevation of Victoria Island would be maintained at 4.0 feet above MSL when 15,000 cfs is being conveyed through the system. The water surface elevation would be maintained by the pumping plant located at the downstream end of Woodward Island. The connection to Clifton Court Forebay from Victoria Island would be made through two 24' x 24' x 1,400' concrete box siphons that would have radial gate control structures located at the siphon outlets to Clifton Court Forebay.

SWP and CVP Delta Pumping Facility Improvements

The Skinner Delta Fish Protective Facility, which screens diversions for the SWP's Banks Pumping Plant, would be upgraded with the best available technology for fish screens. The new screens would be designed under the guidance of State and federal regulating agencies. An interconnection between Clifton Court Forebay and lower portion of the Delta-Mendota Canal would also be constructed on the south side of the forebay. This interconnection would allow water stored in Clifton Court Forebay or in either Chain of Lakes Alternative to be diverted to the CVP's Tracy Pumping Plant for pumping and delivery to the Delta-Mendota Canal. The interconnection would be gated to maximize the operational flexibility of the system. An additional gate would be constructed on the Delta-Mendota Canal just downstream of the interconnection. The gate on the Delta-Mendota Canal would enable flows to be released into the Delta-Mendota Canal from Clifton Court Forebay during low tide conditions. The existing fish screens associated with the Tracy Pumping Plant would be upgraded with screens similar to those that would be installed at the Skinner facility.

COST ESTIMATE

The Chain of Lakes Project is a relatively new project that has not been previously studied; thus there is no specific previous information describing or estimating the cost of the project. There are, however, some studies with similar components from which comparative costs could be derived. The cost estimate for the Chain of Lakes Project was developed primarily by Bookman-

Edmonston Engineering and was based on applicable portions of previous studies, experience, and engineering judgment. These previous studies include the 1990 DWR report *North Delta Program Draft EIR/EIS*, the 1995 DWR report *Isolated Transfer Facility Cost Estimate*, and the 1990 DWR report, *Los Banos Grandes Facilities Report, Appendix A: Designs and Cost Estimates.*

COST ESTIMATE METHODOLOGY

The cost estimates for the Chain of Lakes Project were determined by applying current unit costs to the quantities developed by Bookman-Edmonston Engineering. Some of the costs used to prepare this cost estimate were determined by escalating the unit cost to October 1996 dollars using Reclamation's Construction Cost Trends (CCT) indices. Additional unit costs were developed by Bookman-Edmonston Engineering based on engineering and construction experience. The cost estimate does not include the cost of environmental documentation, environmental mitigation, operation and maintenance, power, and interest during construction.

Tables 2a and 2b provide a detailed breakdown of the estimated costs of the Chain of Lakes Project — Siphon Only Alternative and the Chain of Lakes Project — Siphon and Pump Alternative, respectively. Cost items identified in previous cost estimates have been provided, along with the unit cost of the items or an indication that the estimated cost has been developed through a lump sum approach. The tables also include the Reclamation CCT index for the month and year in which the estimated cost was developed and for October 1996. These Reclamation cost indices are used to factor the previous cost estimate to October 1996 dollars. In some instances, only a unit cost has been provided, with no cost indices. In these cases, the unit cost has been taken from other sources. The far right-hand column of Table 2a and 2b provides the cost reference for each cost item.

Pumping Plants

The cost estimate for the pumping plants associated with the Chain of Lakes Project has been based on the cost and quantities from the September 1995 DWR Report, *Isolated Transfer Facility Cost Estimate*. These costs were originally priced in July 1995 dollars and have been updated to October 1996 dollars using the CCT indices described above.

Right-of-Way Costs

Right-of-way costs of $3,000 per acre were used based upon personal communication with Reclamation's Division of Land Resources staff in February 1997. The right-of-way necessary for the development of the Chain of Lakes Project would require 36,491 acres for the seven Delta islands in the system.

Contingencies and Other Costs

All contingencies and engineering, construction management, and administrative factors were determined by engineering judgment based on similar level of cost estimation. Contingencies were chosen to be 20 percent; engineering, construction management, and administration were chosen to be 35 percent. A cost range was developed for the project by subtracting 10 percent from the estimated capital cost for the low-end cost and adding 25 percent to the estimated capital cost for the high-end cost.

PRELIMINARY COST FINDINGS

Costs of the Chain of Lakes Project and supporting facilities have been developed to an October 1996 basis as described above. Table 3 summarizes estimated costs of the major items associated with the Chain of Lakes Project for both the Siphon Only Alternative and the Siphon and Pump Alternative.

The total estimated capital cost of the Siphon Only Alternative is estimated to be about $1,832 million with a resulting calculated cost range between $2,671 and $3,710 million.

The total estimated capital cost of the Siphon and Pump Alternative is estimated to be about $2,878 million with a resulting calculated cost range between $2,590 and $3,597 million.

ENVIRONMENTAL DOCUMENTATION

[NOTE: The environmental considerations section needs to be reevaluated by DWR to ensure consistency with the information presented in the previous section.]

This portion of the report provides a summary of environmental considerations related to the Chain of Lakes Project. Fish, wildlife, plant, and cultural resources that could be affected by the proposal are described and the extent of the impacts are identified. The information presented in this section was gathered from existing literature, with limited original research. No field work was conducted for this analysis.

WILDLIFE

This conveyance option would impact 16,000 acres of agricultural lands. No riparian areas would be affected.

Fish, Amphibians, Reptiles, and Invertebrates

The Delta supports several types of aquatic habitats including estuary, freshwater, and marine water environments. These various water environments support about 90 species of fish.

During construction, the conveyance options could affect several waterways that support both anadromous and resident game and non-game fish. Permanent residents or fish dependant on the

Delta as a migration corridor or as a nursery include striped bass, chinook salmon, steelhead trout, American shad, sturgeon, catfish, largemouth bass, winter-run chinook salmon, delta smelt, Sacramento splittail, and numerous other marine and freshwater species.

Amphibians in the area include the California tiger salamander, which requires quiet, still water for breeding. The major waterways in the area are deep, swift, and subject to frequent inundation to provide suitable habitat for this species.

General Wildlife

Lands within the areas of the proposed improved Delta conveyance support a highly diverse wildlife. Important groups of wildlife dependant on the Delta environment are waterfowl and other migratory birds, game birds such as pheasant and quail, furbearers, and numerous nongame birds and mammals. The Delta is particularly important to waterfowl migrating via the Pacific Flyway. The principal attraction for waterfowl is winter flooded agricultural fields, mainly cereal crops, which provide food and extensive seasonal wetlands. Small mammals find suitable habitat in the Delta and upland areas. Vegetated levees, remanent of riparian forest, and undeveloped islands provide habitat for numerous small mammals. Small mammal species include muskrat, mink, river otter, beaver, raccoon, gray fox, and skunks. A variety of non-game wildlife such as songbirds, hawks, owl, reptiles, and amphibians can also be found in the area.

Sensitive and Listed Fish and Wildlife Species

According to the California National Diversity Database, listed species recorded in or around the area that would be directly affected by any of the proposed project include California red-legged frog (federal threatened), Swainson's hawk (State threatened), California black rail (State threatened), San Joaquin kit fox (federal endangered, State threatened), giant garter snake (federal/State threatened), and valley elderberry longhorn beetle (federal threatened).

Wildlife species that are either candidates for State and federal listing or considered species of special concern by the California Department of Fish and Game (CDFG) that have been known to occur in or near the area affected by any of the proposed through Delta conveyance alternatives include California tiger salamander (federal candidate/CDFG species of special concern), great blue heron, great egret, white-tailed kite, burrowing owl (CDFG/Audubon species of special concern), tricolored blackbird (federal candidate, CDFG species of special concern), Sacramento splittail (federal proposed endangered, CDFG species of special concern), San Joaquin pocket mouse (CDFG species of special concern), and western pond turtle.

Other sensitive wildlife species that are candidates for federal listing that have not been previously recorded, but may be present in the area of the proposed conveyance alignment, include the San Joaquin valley wood rat, riparian brush rabbit, greater western mastiff bat, small-footed myotis bat, long-eared myotis bat, fringed myotis bat, long-legged myotis bat, Yuma myotis bat, Pacific western big-eared bat, bells sage sparrow, western burrowing owl, feruginous hawk, mountain plover, little willow flycatcher, white faced ibis, silvery legless lizard, southwestern pond turtle, San Joaquin whipsnake, California horned lizard, western spadefoot toad, green sturgeon, river lamprey, Kern brook lamprey, Pacific lamprey, longfin smelt, Antioch Dunes anthicid beetle, Sacramento anthicid beetle, and molestan blister beetle.

Limited sporadic use of the project area may occur for wintering greater sandhill cranes. This species (State-listed threatened) is a common winter migrant to the eastern Sacramento Valley. While the crane does not nest in the project area, it could use the open grasslands for foraging.

Bald eagle, peregrine falcon, yellow-billed cuckoo, and Aleutian Canada goose have been observed in the Delta, but none are confined exclusively to the area.

Habitat suitable for the California black rail can be found in the area of Little Potato Slough at its confluence with White Slough and on the islands in the Middle River area north of Woodward Ferry.

Suitable habitat for western pond turtles occurs along all water courses in the area. Previous surveys have recorded turtles in Lost Slough, Snodgrass Slough, South Fork Mokelumne River, and the Old and Middle Rivers.

Elderberry is widely distributed and is a common component of the mixed riparian woodland community of the Delta. These plants are considered potential habitat for the valley elderberry longhorn beetle.

VEGETATION

This Delta conveyance option would affect approximately 16,000 acres of agricultural and disturbed lands. No riparian lands would be affected.

SENSITIVE AND LISTED PLANT SPECIES

A federal candidate and State-listed rare plant, Mason's lilaeopsis, has been known to occur in the area that could be affected by the proposed conveyance option.

Candidate plant species for federal listing that may occur in the project area include Suisun Marsh aster, caper-fruited tropidocarpum, San Joaquin saltbush, Ferris's milk vetch, Delta tule pea, and recurved larkspur.

Additional plants listed by the California Native Plant Society as being rare, threatened or endangered in California and elsewhere, could also be affected by the proposed through Delta conveyance options. These plants include big tarweed, Wright's trichocoronis, marsh skullcap, California hibiscus, heartscale, Delta mudwort, and bristly sedge.

Special-status habitats that may be found along or near the area of the proposed project include valley sink scrub, northern hardpan vernal pool, northern claypan vernal pool, alkali meadow,

coastal and valley freshwater marsh, Great Valley mixed riparian forest, Great Valley oak riparian forest, and Valley Oak woodland.

Wetlands

Information gathered from the U.S. Fish and Wildlife Services' National Wetland Inventory map indicates that within the area that would be affected by the proposed project, there are approximately 9 miles of farmed wetlands, 3 miles of scrub-shrub seasonal tidal wetlands, seven acres of scrub-shrub seasonally flooded wetlands (shallow marsh), and 28 acres of deep marsh.

Four special-status wetland habitats (northern hardpan vernal pool, northern claypan vernal pool, alkali meadow, and coastal and valley freshwater marsh) could be affected by the proposed through Delta conveyance options.

CULTURAL RESOURCES

Generally, archaeological sites throughout the Delta province may be overrepresented. Historic activities connected with channel dredging, levee construction and maintenance, residential development, and agriculture have obscured, buried, and destroyed many sites since the first half of the twentieth century, when most were first found. Additionally, some may now be buried under alluvium.

Prehistoric settlements in the Delta were situated on low rises above flood level, on mounds on low knolls, on natural levees, and on higher ground along the banks of streams and rivers. Reclamation and farming activities have leveled most of these areas of higher relief. Field inspection will be necessary to verify the existence and condition of these sites for a more accurate assessment.

Historic period sites and features in the Delta province are generally underrepresented. The surveys responsible for identifying most of the archaeological sites were carried out by the University of California at Berkeley during the time when there was little concern for historic period resources. Almost all of them have been recorded since the 1970s.

In addition to farmsteads, ranches, and townsites, other resources noted on the quadrangle maps will require evaluation. These resources include levees, pumphouses, pumping stations, windmills, railroad grades, roads, bridges, pilings, piers, landings, and gas wells.

Review of the base maps and site records at the North Central (CSU at Sacramento), Central California (CSU at Stanislaus), Northwest (Sonoma State University), and Northeast Information Centers indicates that this option may affect a total of seven historic sites (non-significant). One is a trash scatter and six are associated with George Shima's agricultural operations. They represent a labor camp for Asian farm workers during the 1900-1920 period. Singly, the six Shima farm sites are not significant, but collectively they may be eligible to the National Register of Historic Places as a Historic District.

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Table 1

SUMMARY OF PHYSICAL CHARACTERISTICS
CHAIN OF LAKES PROJECT

	Siphon Only Alternative	Siphon and Pump Alternative
Delta Cross Channel Enlargement		
Capacity (cfs)	10,000	10,000
Pump Station Capacity (cfs)	10,000	10,000
Horsepower (HP)	16,610	16,610
Tyler Island		
Maximum Water Surface Elevation (MSL)	6.0	6.0
Maximum Water Storage Capacity (Acre-feet)	185,595	185,595
Operating Water Surface Elevation (MSL)	6.0	6.0
Operating Storage Capacity (Acre-feet)	185,595	185,595
Siphons		
Length (feet)	1,100	1,100
Boxes	3 - 30' x 30'	2 - 23' x 23'
Distributed Pump Stations		
Total Capacity (cfs)	5,000	5,000
Total Horsepower (HP)	7,570	7,570
Bouldin Island		
Maximum Water Surface Elevation (MSL)	6.0	6.0
Maximum Water Storage Capacity (Acre-feet)	182,900	182,900
Operating Water Surface Elevation (MSL)	5.0	-0.8
Operating Storage Capacity (Acre-feet)	174,300	129,130
Siphons		
Length (feet)	700	700
Boxes	3 - 30' x 30'	2 - 23' x 23'
Distributed Pump Stations		
Total Capacity (cfs)	5,000	5,000
Total Horsepower (HP)	7,570	7,570
Conveyance Pump Station		
Total Capacity (cfs)	--	15,000
Total Horsepower (HP)	--	25,080
Venice Island		
Maximum Water Surface Elevation (MSL)	6.0	6.0
Maximum Water Storage Capacity (Acre-feet)	92,700	92,700
Operating Water Surface Elevation (MSL)	4.0	6.0
Operating Storage Capacity (Acre-feet)	85,700	92,700
Siphons		
Length (feet)	1,700	1,700
Boxes	3 - 30' x 30'	2 - 23' x 23'
Distributed Pump Stations		
Total Capacity (cfs)	5,000	5,000
Total Horsepower (HP)	7,570	7,570
Mandeville Island		
Maximum Water Surface Elevation (MSL)	6.0	6.0
Maximum Water Storage Capacity (Acre-feet)	131,700	131,700
Operating Water Surface Elevation (MSL)	2.8	-2.0
Operating Storage Capacity (Acre-feet)	114,700	89,900
Sipons		
Length (feet)	900	900

Table 1 (Continued)
SUMMARY OF PHYSICAL CHARACTERISTICS
CHAIN OF LAKES PROJECT

	Siphon Only Alternative	Siphon and Pump Alternative
Boxes	3 - 30' x 30'	2 - 23' x 23'
Distributed Pump Stations		
Total Capacity (cfs)	5,000	5,000
Total Horsepower (HP)	7,570	7,570
Conveyance Pump Station		
Total Capacity (cfs)	--	15,000
Total Horsepower (HP)	--	25,080
Bacon Island		
Maximum Water Surface Elevation (MSL)	6.0	6.0
Maximum Water Storage Capacity (Acre-feet)	117,700	117,700
Operating Water Surface Elevation (MSL)	1.8	6.0
Operating Storage Capacity (Acre-feet)	98,600	117,700
Siphons		
Length (feet)	1,500	1,500
Boxes	3 - 30' x 30'	2 - 23' x 23'
Distributed Pump Stations		
Total Capacity (cfs)	5,000	5,000
Total Horsepower (HP)	7,570	7,570
Woodward Island		
Maximum Water Surface Elevation (MSL)	6.0	6.0
Maximum Water Storage Capacity (Acre-feet)	20,900	20,900
Operating Water Surface Elevation (MSL)	0.7	-1.6
Operating Storage Capacity (Acre-feet)	15,400	13,400
Siphons		
Length (feet)	700	700
Boxes	3 - 30' x 30'	2 - 23' x 23'
Distributed Pump Stations		
Total Capacity (cfs)	5,000	5,000
Total Horsepower (HP)	7,570	7,570
Conveyance Pump Station		
Total Capacity (cfs)	--	15,000
Total Horsepower (HP)	--	25,080
Victoria Island		
Maximum Water Surface Elevation (MSL)	6.0	6.0
Maximum Water Storage Capacity (Acre-feet)	104,900	104,900
Operating Water Surface Elevation (MSL)	-0.2	6.0
Operating Storage Capacity (Acre-feet)	74,300	104,900
Siphons		
Length (feet)	1,400	1,400
Boxes	3 - 30' x 30'	2 - 24' x 24'
Distributed Pump Stations		
Total Capacity (cfs)	5,000	5,000
Total Horsepower (HP)	7,570	7,570

Table 2a
ESTIMATED COSTS
CHAIN OF LAKES PROJECT - SIPHON ONLY ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
I. DELTA CROSS CHANNEL ENLARGEMENT								
Highway 160 Bridge	21,000	SF				$100	$2,100,000	1
Enlarge Gate Structure	JOB	LS	168	213	$18,612,000	$23,597,000	$23,597,000	2, page 437
Open Channel and Snodgrass Slough								
Riprap	226,100	TON	163	181	$15.00	$16.70	$3,775,870	2, page 439
Bedding (6" thick)	63,900	TON	163	181	$14.00	$15.60	$996,840	2, page 439
Geotextile (bedding)	1,438,200	SF	163	181	$0.25	$0.28	$402,696	2, page 439
Embankment	1,017,900	CY	163	181	$7.00	$7.80	$7,939,620	2, page 439
Foundation	407,300	CY	163	181	$9.80	$10.90	$4,439,570	1
Land Acquisition								
North Bank (300' wide)	19	AC				$3,000	$57,000	3
South Bank (1,000' wide)	26	AC				$3,000	$78,000	3
Fish Screens								
Fish Screen Installation	10,000	CFS				$10,000	$100,000,000	1
Pump Station (Q=10,000 cfs)	JOB	LS				$46,342,000	$46,342,000	1
Control Building	1,500	SF				$150	$225,000	1
Miscellaneous (fencing, parking)	JOB	LS				$50,000	$50,000	
SUBTOTAL DELTA CROSS CHANNEL ENLARGEMENT							$190,003,596	
II. TYLER ISLAND								
Land Acquisition	8,818	AC				$3,000	$26,454,000	
Levees								
Riprap	1,509,900	TON	163	181	$15.00	$16.70	$25,215,330	2, page 439
Bedding (6" thick)	426,800	TON	163	181	$14.00	$15.60	$6,658,080	2, page 439
Geotextile (bedding)	9,605,100	SF	163	181	$0.25	$0.28	$2,689,428	2, page 439
Embankment	490,500	CY	163	181	$7.00	$7.80	$3,825,900	2, page 439
Bridge (Thornton-Walnut Grove Road)	25,200	SF				$100	$2,520,000	1
Intake Pump Station w/ fish screens (Q=5,000 cfs)	JOB	LS				$80,575,000	$80,575,000	1
Tyler-Bouldin Siphon (1100 ft)[b]								
Temporary River Alignment								
Excavation	55,451	CY	181	181	$2.50	$2.50	$138,628	5, page 7
Levees (using excavation)	55,451	CY	181	181	$3.00	$3.00	$166,353	5, page 7
Cofferdam Sheetpiling	301,600	SF	202	207	$28.00	$28.70	$8,655,920	5, page 7
Cofferdam Gravel Fill	29,600	CY	202	207	$21.00	$21.50	$636,400	5, page 7
Backfill	55,451	CY	181	181	$4.00	$4.00	$221,804	5, page 7
Dewatering	JOB	LS	202	207	$100,000	$102,500	$102,500	5, page 7
Siphon								
Excavation-Structural	757,900	CY	181	181	$6.00	$6.00	$4,547,400	5, page 7
Concrete	79,200	CY	198	213	$275	$296	$23,443,200	5, page 7
Reinforcing Steel	15,752,000	LBS	198	213	$0.60	$0.65	$10,238,800	5, page 7

Table 2a
ESTIMATED COSTS
CHAIN OF LAKES PROJECT - SIPHON ONLY ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Backfill	393,800	CY	181	181	$4.00	$4.00	$1,575,200	5, page 7
Riprap	119,900	TON	181	181	$27.00	$27.00	$3,237,300	5, page 7
Access Roads	0.76	MI	231	237	$500,000	$513,000	$389,880	5, page 7
Inlet and Outlet Transition								
Excavation	124,700	CY	181	181	$2.25	$2.25	$280,575	5, page 7
Concrete Slab	3,320	CY	198	213	$225	$242	$803,440	5, page 7
Concrete Walls	2,640	CY	198	213	$350	$377	$995,280	5, page 7
Reinforcing Steel	1,190,000	LBS	198	213	$0.60	$0.65	$773,500	5, page 7
Backfill	27,800	CY	181	181	$4.00	$4.00	$111,200	5, page 7
Miscellaneous @ 20%							$11,263,476	
SUBTOTAL TYLER ISLAND							$215,518,593	
III. BOULDIN ISLAND								
Land Acquisition	5,913	AC				$3,000	$17,739,000	3
Purchase Homes	4	EA				$200,000	$800,000	1
Levees								
Riprap	1,189,300	TON	163	181	$15.00	$16.70	$19,861,310	2, page 439
Bedding (6" thick)	336,200	TON	163	181	$14.00	$15.60	$5,244,720	2, page 439
Geotextile (bedding)	7,565,500	SF	163	181	$0.25	$0.28	$2,118,340	2, page 439
Embankment	386,400	CY	163	181	$7.00	$7.80	$3,013,920	2, page 439
Bridge	21,000	SF				$100	$2,100,000	1
Elevated Roadway								
Riprap	590,300	TON	163	181	$15.00	$16.70	$9,858,010	2, page 439
Bedding (6" thick)	166,900	TON	163	181	$14.00	$15.60	$2,603,640	2, page 439
Geotextile (bedding)	3,755,300	SF	163	181	$0.25	$0.28	$1,051,484	2, page 439
Embankment	2,663,400	CY	163	181	$7.00	$7.80	$20,774,520	2, page 439
Foundation	1,269,000	CY	163	181	$9.80	$10.90	$13,832,100	1
Aggregate Base	15,510	TON				$19.15	$297,017	4, item V-d
Asphalt Concrete	7,050	TON				$58.92	$415,386	4, item V-e
Intake Pump Station w/ fish screens (Q=5,000 cfs)	JOB	LS				$80,575,000	$80,575,000	1
Bouldin-Venice Siphon (700 ft)[b]								
Temporary River Alignment								
Excavation	35,287	CY	181	181	$2.50	$2.50	$88,218	5, page 7
Levees (using excavation)	35,287	CY	181	181	$3.00	$3.00	$105,861	5, page 7
Cofferdam Sheetpiling	150,800	SF	202	207	$28.00	$28.70	$4,327,960	5, page 7
Cofferdam Gravel Fill	14,800	CY	202	207	$21.00	$21.50	$318,200	5, page 7
Backfill	35,287	CY	181	181	$4.00	$4.00	$141,148	5, page 7
Dewatering	JOB	LS	202	207	$100,000	$102,500	$102,500	5, page 7
Siphon								
Excavation-Structural	482,300	CY	181	181	$6.00	$6.00	$2,893,800	5, page 7

Table 2a
ESTIMATED COSTS
CHAIN OF LAKES PROJECT - SIPHON ONLY ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Concrete	50,400	CY	198	213	$275	$296	$14,918,400	5, page 7
Reinforcing Steel	10,024,000	LBS	198	213	$0.60	$0.65	$6,515,600	5, page 7
Backfill	250,600	CY	181	181	$4.00	$4.00	$1,002,400	5, page 7
Riprap	76,300	TON	181	181	$27.00	$27.00	$2,060,100	5, page 7
Access Roads	0.48	MI	231	237	$500,000	$513,000	$246,240	5, page 7
Inlet and Outlet Transition								
Excavation	124,700	CY	181	181	$2.25	$2.25	$280,575	5, page 7
Concrete Slab	3,320	CY	198	213	$225	$242	$803,440	5, page 7
Concrete Walls	2,640	CY	198	213	$350	$377	$995,280	5, page 7
Reinforcing Steel	1,190,000	LBS	198	213	$0.60	$0.65	$773,500	5, page 7
Backfill	27,800	CY	181	181	$4.00	$4.00	$111,200	5, page 7
Miscellaneous @ 20%							$7,136,884	
SUBTOTAL BOULDIN ISLAND							$223,105,752	
IV. VENICE ISLAND								
Land Acquisition	3,103	AC				$3,000	$9,309,000	3
Levees								
Riprap	817,300	TON	163	181	$15.00	$16.70	$13,648,910	2, page 439
Bedding (6" thick)	231,000	TON	163	181	$14.00	$15.60	$3,603,600	2, page 439
Geotextile (bedding)	5,199,000	SF	163	181	$0.25	$0.28	$1,455,720	2, page 439
Embankment	265,500	CY	163	181	$7.00	$7.80	$2,070,900	2, page 439
Intake Pump Station w/ fish screens (Q=5,000 cfs)	JOB	LS				$80,575,000	$80,575,000	1
Venice-Mandeville Siphon (1700 ft)[b]								
Temporary River Alignment								
Excavation	85,697	CY	181	181	$2.50	$2.50	$214,243	5, page 7
Levees (using excavation)	85,697	CY	181	181	$3.00	$3.00	$257,091	5, page 7
Cofferdam Sheetpiling	527,800	SF	202	207	$28.00	$28.70	$15,147,860	5, page 7
Cofferdam Gravel Fill	51,800	CY	202	207	$21.00	$21.50	$1,113,700	5, page 7
Backfill	85,697	CY	181	181	$4.00	$4.00	$342,788	5, page 7
Dewatering	JOB	LS	202	207	$100,000	$102,500	$102,500	5, page 7
Siphon								
Excavation-Structural	1,096,500	CY	181	181	$6.00	$6.00	$6,579,000	5, page 7
Concrete	113,900	CY	198	213	$275	$296	$33,714,400	5, page 7
Reinforcing Steel	22,780,000	LBS	198	213	$0.60	$0.65	$14,807,000	5, page 7
Backfill	569,500	CY	181	181	$4.00	$4.00	$2,278,000	5, page 7
Riprap	173,400	TON	181	181	$27.00	$27.00	$4,681,800	5, page 7
Access Roads	1.09	MI	231	237	$500,000	$513,000	$559,170	5, page 7
Inlet and Outlet Transition								
Excavation	120,300	CY	181	181	$2.25	$2.25	$270,675	5, page 7
Concrete Slab	3,200	CY	198	213	$225	$242	$774,400	5, page 7

Table 2a
ESTIMATED COSTS
CHAIN OF LAKES PROJECT - SIPHON ONLY ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Concrete Walls	2,540	CY	198	213	$350	$377	$957,580	5, page 7
Reinforcing Steel	1,148,000	LBS	198	213	$0.60	$0.65	$746,200	5, page 7
Backfill	26,800	CY	181	181	$4.00	$4.00	$107,200	5, page 7
Miscellaneous @ 20%							$16,530,721	
SUBTOTAL VENICE ISLAND							$209,847,458	
V. MANDEVILLE ISLAND								
Land Acquisition	5,214	AC				$3,000	$15,642,000	3
Levees								
Riprap	953,800	TON	163	181	$15.00	$16.70	$15,928,460	2, page 439
Bedding (6" thick)	269,600	TON	163	181	$14.00	$15.60	$4,205,760	2, page 439
Geotextile (bedding)	6,067,600	SF	163	181	$0.25	$0.28	$1,698,928	2, page 439
Embankment	309,900	CY	163	181	$7.00	$7.80	$2,417,220	2, page 439
Intake Pump Station w/ fish screens (Q=5,000 cfs)	JOB	LS				$80,575,000	$80,575,000	1
Mandeville-Bacon Siphon (900 ft)[b]								
Temporary River Alignment								
Excavation	45,369	CY	181	181	$2.50	$2.50	$113,423	5, page 7
Levees (using excavation)	45,369	CY	181	181	$3.00	$3.00	$136,107	5, page 7
Cofferdam Sheetpiling	226,200	SF	202	207	$28.00	$28.70	$6,491,940	5, page 7
Cofferdam Gravel Fill	22,200	CY	202	207	$21.00	$21.50	$477,300	5, page 7
Backfill	45,369	CY	181	181	$4.00	$4.00	$181,476	5, page 7
Dewatering	JOB	LS	202	207	$100,000	$102,500	$102,500	5, page 7
Siphon								
Excavation-Structural	580,500	CY	181	181	$6.00	$6.00	$3,483,000	5, page 7
Concrete	60,300	CY	198	213	$275	$296	$17,848,800	5, page 7
Reinforcing Steel	12,060,000	LBS	198	213	$0.60	$0.65	$7,839,000	5, page 7
Backfill	301,500	CY	181	181	$4.00	$4.00	$1,206,000	5, page 7
Riprap	98,100	TON	181	181	$27.00	$27.00	$2,648,700	5, page 7
Access Roads	0.62	MI	231	237	$500,000	$513,000	$318,060	5, page 7
Inlet and Outlet Transition								
Excavation	124,700	CY	181	181	$2.25	$2.25	$280,575	5, page 7
Concrete Slab	3,320	CY	198	213	$225	$242	$803,440	5, page 7
Concrete Walls	2,640	CY	198	213	$350	$377	$995,280	5, page 7
Reinforcing Steel	1,190,000	LBS	198	213	$0.60	$0.65	$773,500	5, page 7
Backfill	27,800	CY	181	181	$4.00	$4.00	$111,200	5, page 7
Miscellaneous @ 20%							$8,762,060	
SUBTOTAL MANDEVILLE ISLAND							$173,039,729	

Table 2a
ESTIMATED COSTS
CHAIN OF LAKES PROJECT - SIPHON ONLY ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
VI. BACON ISLAND								
Land Acquisition	5,066	AC				$3,000	$15,198,000	
Levees								
Riprap	914,600	TON	163	181	$15.00	$16.70	$15,273,820	2, page 439
Bedding (6" thick)	258,500	TON	163	181	$14.00	$15.60	$4,032,600	2, page 439
Geotextile (bedding)	5,818,200	SF	163	181	$0.25	$0.28	$1,629,096	2, page 439
Embankment	297,100	CY	163	181	$7.00	$7.80	$2,317,380	2, page 439
Intake Pump Station w/ fish screens (Q=5,000 cfs)	JOB	LS				$80,575,000	$80,575,000	1
Bacon-Woodward Siphon (1500 ft)[b]								
Temporary River Alignment								
Excavation	75,615	CY	181	181	$2.50	$2.50	$189,038	5, page 7
Levees (using excavation)	75,615	CY	181	181	$3.00	$3.00	$226,845	5, page 7
Cofferdam Sheetpiling	226,200	SF	202	207	$28.00	$28.70	$6,491,940	5, page 7
Cofferdam Gravel Fill	22,200	CY	202	207	$21.00	$21.50	$477,300	5, page 7
Backfill	75,615	CY	181	181	$4.00	$4.00	$302,460	5, page 7
Dewatering	JOB	LS	202	207	$100,000	$102,500	$102,500	5, page 7
Siphon								
Excavation-Structural	1,033,500	CY	181	181	$6.00	$6.00	$6,201,000	5, page 7
Concrete	108,000	CY	198	213	$275	$296	$31,968,000	5, page 7
Reinforcing Steel	21,480,000	LBS	198	213	$0.60	$0.65	$13,962,000	5, page 7
Backfill	537,000	CY	181	181	$4.00	$4.00	$2,148,000	5, page 7
Riprap	163,500	TON	181	181	$27.00	$27.00	$4,414,500	5, page 7
Access Roads	1.04	MI	231	237	$500,000	$513,000	$533,520	5, page 7
Inlet and Outlet Transition								
Excavation	124,700	CY	181	181	$2.25	$2.25	$280,575	5, page 7
Concrete Slab	3,320	CY	198	213	$225	$242	$803,440	5, page 7
Concrete Walls	2,640	CY	198	213	$350	$377	$995,280	5, page 7
Reinforcing Steel	1,190,000	LBS	198	213	$0.60	$0.65	$773,500	5, page 7
Backfill	27,800	CY	181	181	$4.00	$4.00	$111,200	5, page 7
Miscellaneous @ 20%							$13,996,220	
SUBTOTAL BACON ISLAND							$203,003,213	
VII. WOODWARD ISLAND								
Land Acquisition	1,565	AC				$3,000	$4,695,000	3
Levees								
Riprap	561,600	TON	163	181	$15.00	$16.70	$9,378,720	2, page 439
Bedding (6" thick)	158,800	TON	163	181	$14.00	$15.60	$2,477,280	2, page 439
Geotextile (bedding)	3,572,400	SF	163	181	$0.25	$0.28	$1,000,272	2, page 439
Embankment	182,500	CY	163	181	$7.00	$7.80	$1,423,500	2, page 439
Intake Pump Station w/ fish screens (Q=5,000 cfs)	JOB	LS				$80,575,000	$80,575,000	1

Table 2a
ESTIMATED COSTS
CHAIN OF LAKES PROJECT - SIPHON ONLY ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Woodward-Victoria Siphon (700 ft)[b]								
Temporary River Alignment								
Excavation	35,287	CY	181	181	$2.50	$2.50	$88,218	5, page 7
Levees (using excavation)	35,287	CY	181	181	$3.00	$3.00	$105,861	5, page 7
Cofferdam Sheetpiling	150,800	SF	202	207	$28.00	$28.70	$4,327,960	5, page 7
Cofferdam Gravel Fill	14,800	CY	202	207	$21.00	$21.50	$318,200	5, page 7
Backfill	35,287	CY	181	181	$4.00	$4.00	$141,148	5, page 7
Dewatering	JOB	LS	202	207	$100,000	$102,500	$102,500	5, page 7
Siphon								
Excavation-Structural	482,300	CY	181	181	$6.00	$6.00	$2,893,800	5, page 7
Concrete	50,400	CY	198	213	$275	$296	$14,918,400	5, page 7
Reinforcing Steel	10,024,000	LBS	198	213	$0.60	$0.65	$6,515,600	5, page 7
Backfill	250,600	CY	181	181	$4.00	$4.00	$1,002,400	5, page 7
Riprap	76,300	TON	181	181	$27.00	$27.00	$2,060,100	5, page 7
Access Roads	0.48	MI	231	237	$500,000	$513,000	$246,240	5, page 7
Inlet and Outlet Transition								
Excavation	124,700	CY	181	181	$2.25	$2.25	$280,575	5, page 7
Concrete Slab	3,320	CY	198	213	$225	$242	$803,440	5, page 7
Concrete Walls	2,640	CY	198	213	$350	$377	$995,280	5, page 7
Reinforcing Steel	1,190,000	LBS	198	213	$0.60	$0.65	$773,500	5, page 7
Backfill	27,800	CY	181	181	$4.00	$4.00	$111,200	5, page 7
Miscellaneous @ 20%							$7,136,884	
SUBTOTAL WOODWARD ISLAND							$142,371,078	
VIII. VICTORIA ISLAND								
Land Acquisition	6,767	AC				$3,000	$20,301,000	3
Levees								
Riprap	973,500	TON	163	181	$15.00	$16.70	$16,257,450	2, page 439
Bedding (6" thick)	275,200	TON	163	181	$14.00	$15.60	$4,293,120	2, page 439
Geotextile (bedding)	6,192,500	SF	163	181	$0.25	$0.28	$1,733,900	2, page 439
Embankment	316,200	CY	163	181	$7.00	$7.80	$2,466,360	2, page 439
Bridge	21,000	SF				$100	$2,100,000	1
Elevated Roadway (Highway 4)								
Riprap	570,200	TON	163	181	$15.00	$16.70	$9,522,340	2, page 439
Bedding (6" thick)	161,200	TON	163	181	$14.00	$15.60	$2,514,720	2, page 439
Geotextile (bedding)	3,627,500	SF	163	181	$0.25	$0.28	$1,015,700	2, page 439
Embankment	819,800	CY	163	181	$7.00	$7.80	$6,394,440	2, page 439
Foundation	740,100	CY	163	181	$9.80	$10.90	$8,067,090	
Aggregate Base	14,980	TON				$19.15	$286,867	4, item v-d
Asphalt Concrete	6,810	TON				$58.92	$401,245	4, item v-e

Table 2a
ESTIMATED COSTS
CHAIN OF LAKES PROJECT - SIPHON ONLY ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Intake Pump Station w/ fish screens (Q=5,000 cfs)	JOB	LS				$80,575,000	$80,575,000	1
Victoria-CCFB Siphon (1400 ft)[b]								
Temporary River Alignment								
Excavation	70,574	CY	181	181	$2.50	$2.50	$176,435	5, page 7
Levees (using excavation)	70,574	CY	181	181	$3.00	$3.00	$211,722	5, page 7
Cofferdam Sheetpiling	150,800	SF	202	207	$28.00	$28.70	$4,327,960	5, page 7
Cofferdam Gravel Fill	14,800	CY	202	207	$21.00	$21.50	$318,200	5, page 7
Backfill	70,574	CY	181	181	$4.00	$4.00	$282,296	5, page 7
Dewatering	JOB	LS	202	207	$100,000	$102,500	$102,500	5, page 7
Siphon								
Excavation-Structural	964,600	CY	181	181	$6.00	$6.00	$5,787,600	5, page 7
Concrete	100,800	CY	198	213	$275	$296	$29,836,800	5, page 7
Reinforcing Steel	20,048,000	LBS	198	213	$0.60	$0.65	$13,031,200	5, page 7
Backfill	501,200	CY	181	181	$4.00	$4.00	$2,004,800	5, page 7
Riprap	152,600	TON	181	181	$27.00	$27	$4,120,200	5, page 7
Access Roads	0.97	MI	231	237	$500,000	$513,000	$497,610	5, page 7
Inlet and Outlet Transition								
Excavation	124,700	CY	181	181	$2.25	$2.25	$280,575	5, page 7
Concrete Slab	3,320	CY	198	213	$225	$242	$803,440	5, page 7
Concrete Walls	2,640	CY	198	213	$350	$377	$995,280	5, page 7
Reinforcing Steel	1,190,000	LBS	198	213	$0.60	$0.65	$773,500	5, page 7
Backfill	27,800	CY	181	181	$4.00	$4.00	$111,200	5, page 7
Radial Gates and Hoist Assemblies	2	EA				$255,000	$510,000	
Miscellaneous @ 20%							$12,834,264	
Victoria Island Pumping Plant (Q=15,000 cfs)	JOB	LS				$59,106,000	$59,106,000	
SUBTOTAL VICTORIA ISLAND							$292,040,814	
IX. SEEPAGE INTERCEPTION WELLS	JOB	LS				$13,927,000	$13,927,000	1
X. CVP-SWP IMPROVEMENTS								
Fish Screen Improvements at Skinner Fish Facility	10,400	CFS				$10,000	$104,000,000	1
Interconnection Canal to Delta Mendota Canal:								
Excavation	375,000	CY				$2.00	$750,000	1
Compacted Embankment	486,000	CY				$0.80	$388,800	1
Common Embankment	203,000	CY				$0.50	$101,500	1
Borrow	557,000	CY				$5.00	$2,785,000	1
Intake Structure w/ Radial Gates From Clifton Court Forebay	JOB	LS				$9,135,000	$9,135,000	1
Radial Gate Structure on Delta Mendota Canal	JOB	LS				$6,798,000	$6,798,000	1
Fish Screens Tracy Pumping Plant	4,500	CFS				$10,000	$45,000,000	1
SUBTOTAL CVP-SWP IMPROVEMENTS							$168,958,300	

Table 2a
ESTIMATED COSTS
CHAIN OF LAKES PROJECT - SIPHON ONLY ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
SUBTOTAL COST ITEMS FOR CHAIN OF LAKES - SIPHON ONLY ALTERNATIVE							1,831,800,000	
CONTINGENCIES @ 20%							$366,400,000	
ESTIMATED CONSTRUCTION COST							$2,198,200,000	
ENGR., LEGAL, AND ADMIN. @ 35%							$769,400,000	
ESTIMATED CAPITAL COST							$2,967,600,000	
ESTIMATED CAPITAL COST RANGE								
LOW (-10 %)							$2,671,000,000	
HIGH (+25%)							$3,710,000,000	

Footnotes:

[a] SF=square foot; LS=lump sum; CY=cubic yard; AC=acre; CFS=cubic feet per second; HP=horsepower; LBS=pound; MI=mile; EA=each.

[b] The USBR index date for all siphons is September 95, not the October 1990 date shown above.

Cost References:

1. Cost developed by Bookman-Edmonston Engineering.
2. California Department of Water Resources, *North Delta Program Draft EIR, EIS*, November 1990.
3. U.S. Bureau of Reclamation, Land Resources Branch, Graham McMullen, February 1997.
4. California Department of Water Resources, *Los Banos Grandes Facilities Report, Appendix A: Designs and Cost Estimates, December 1990.*
5. California Department of Water Resources, *Isolated Transfer Facility Cost Estimate,* September 1995.
6. U.S. Bureau of Reclamation, *Reconnaissance Estimate, Delta Division--Peripheral Canal*, October 1964.

Table 2b
ESTIMATED COSTS
CHAIN OF LAKES PROJECT - SIPHON AND PUMP ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
I. DELTA CROSS CHANNEL ENLARGEMENT								
Highway 160 Bridge	21,000	SF				$100	$2,100,000	1
Enlarge Gate Structure	JOB	LS	168	213	$18,612,000	$23,597,000	$23,597,000	2, page 437
Open Channel and Snodgrass Slough								
Riprap	226,100	TON	163	181	$15.00	$16.70	$3,775,870	2, page 439
Bedding (6" thick)	63,900	TON	163	181	$14.00	$15.60	$996,840	2, page 439
Geotextile	1,438,200	SF	163	181	$0.25	$0.28	$402,696	2, page 439
Embankment	1,017,900	CY	163	181	$7.00	$7.80	$7,939,620	2, page 439
Foundation	407,300	CY	163	181	$9.80	$10.90	$4,439,570	1
Land Acquisition								
North Bank (300' wide)	19	AC				$3,000	$57,000	3
South Bank (1,000' wide)	26	AC				$3,000	$78,000	3
Fish Screens								
Fish Screen Installation	10,000	CFS				$10,000	$100,000,000	1
Pump Station (Q=10,000 cfs)	JOB	LS				$46,342,000	$46,342,000	1
Control Building	1,500	SF				$150	$225,000	1
Miscellaneous (fencing, parking)	JOB	LS				$50,000	$50,000	
SUBTOTAL DELTA CROSS CHANNEL ENLARGEMENT							$190,003,596	
II. TYLER ISLAND								
Land Acquisition	8,818	AC				$3,000	$26,454,000	
Levees								
Riprap	1,509,900	TON	163	181	$15.00	$16.70	$25,215,330	2, page 439
Bedding (6" thick)	426,800	TON	163	181	$14.00	$15.60	$6,658,080	2, page 439
Geotextile	9,605,100	SF	163	181	$0.25	$0.28	$2,689,428	2, page 439
Embankment	490,500	CY	163	181	$7.00	$7.80	$3,825,900	2, page 439
Bridge (Thornton-Walnut Grove Road)	25,200	SF				$100	$2,520,000	1
Intake Pump Station w/ fish screens (Q=5,000 cfs)	JOB	LS				$80,575,000	$80,575,000	1
Tyler-Bouldin Siphon(1100')[b]								
Temporary River Alignment								
Excavation	55,451	CY	181	181	$2.50	$2.50	$138,628	5, page 7
Levees (using excavation)	55,451	CY	181	181	$3.00	$3.00	$166,353	5, page 7
Cofferdam Sheetpiling	301,600	SF	202	207	$28.00	$28.70	$8,655,920	5, page 7
Cofferdam Gravel Fill	29,600	CY	202	207	$21.00	$21.50	$636,400	5, page 7
Backfill	55,451	CY	181	181	$4.00	$4.00	$221,804	5, page 7
Dewatering	JOB	LS	202	207	$100,000	$102,500	$102,500	5, page 7
Siphon								
Excavation-Structural	297,000	CY	181	181	$6.00	$6.00	$1,782,000	5, page 7
Concrete	30,800	CY	198	213	$275	$296	$9,116,800	5, page 7

Table 2b
ESTIMATED COSTS
CHAIN OF LAKES PROJECT - SIPHON AND PUMP ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Reinforcing Steel	6,182,000	LBS	198	213	$0.60	$0.65	$4,018,300	5, page 7
Backfill	155,100	CY	181	181	$4.00	$4.00	$620,400	5, page 7
Riprap	47,300	TON	181	181	$27.00	$27.00	$1,277,100	5, page 7
Access Roads	0.30	MI	231	237	$500,000	$513,000	$153,900	5, page 7
Inlet and Outlet Transition								
Excavation	64,550	CY	181	181	$2.25	$2.25	$145,238	5, page 7
Concrete Slab	1,720	CY	198	213	$225	$242	$416,240	5, page 7
Concrete Walls	1,370	CY	198	213	$350	$377	$516,490	5, page 7
Reinforcing Steel	616,000	LBS	198	213	$0.60	$0.65	$400,400	5, page 7
Backfill	14,400	CY	181	181	$4.00	$4.00	$57,600	5, page 7
Miscellaneous @ 20%							$5,685,214	
SUBTOTAL TYLER ISLAND							$182,049,024	
III. BOULDIN ISLAND								
Land Acquisition	5,913	AC				$3,000	$17,739,000	3
Purchase Homes	4	EA				$200,000	$800,000	1
Levees								
Riprap	1,189,300	TON	163	181	$15.00	$16.70	$19,861,310	2, page 439
Bedding (6" thick)	336,200	TON	163	181	$14.00	$15.60	$5,244,720	2, page 439
Geotextile (bedding)	7,565,500	SF	163	181	$0.25	$0.28	$2,118,340	2, page 439
Embankment	386,400	CY	163	181	$7.00	$7.80	$3,013,920	2, page 439
Bridge	21,000	SF				$100	$2,100,000	1
Elevated Roadway								
Riprap	590,300	TON	163	181	$15.00	$16.70	$9,858,010	2, page 439
Bedding (6" thick)	166,900	TON	163	181	$14.00	$15.60	$2,603,640	2, page 439
Geotextile (bedding)	3,755,300	SF	163	181	$0.25	$0.28	$1,051,484	2, page 439
Embankment	2,663,400	CY	163	181	$7.00	$7.80	$20,774,520	2, page 439
Foundation	1,269,000	CY	163	181	$9.80	$10.88	$13,809,523	1
Aggregate Base	15,510	TON				$19.15	$297,017	4, item V-d
Asphalt Concrete	7,050	TON				$58.92	$415,386	4, item V-e
Intake Pump Station w/ fish screens (Q=5,000 cfs)	JOB	LS				$80,575,000	$80,575,000	1
Bouldin-Venice Siphon (700')[b]								
Temporary River Alignment								
Excavation	35,287	CY	181	181	$2.50	$2.50	$88,218	5, page 7
Levees (using excavation)	35,287	CY	181	181	$3.00	$3.00	$105,861	5, page 7
Cofferdam Sheetpiling	150,800	SF	202	207	$28.00	$28.70	$4,327,960	5, page 7
Cofferdam Gravel Fill	14,800	CY	202	207	$21.00	$21.50	$318,200	5, page 7
Backfill	35,287	CY	181	181	$4.00	$4.00	$141,148	5, page 7
Dewatering	JOB	LS	202	207	$100,000	$102,500	$102,500	5, page 7

Table 2b
ESTIMATED COSTS
CHAIN OF LAKES PROJECT - SIPHON AND PUMP ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Siphon								
Excavation-Structural	189,000	CY	181	181	$6.00	$6.00	$1,134,000	5, page 7
Concrete	19,600	CY	198	213	$275	$296	$5,801,600	5, page 7
Reinforcing Steel	3,934,000	LBS	198	213	$0.60	$0.65	$2,557,100	5, page 7
Backfill	98,700	CY	181	181	$4.00	$4.00	$394,800	5, page 7
Riprap	30,100	TON	181	181	$27.00	$27.00	$812,700	5, page 7
Access Roads	0.19	MI	231	237	$500,000	$513,000	$97,470	5, page 7
Inlet and Outlet Transition								
Excavation	64,550	CY	181	181	$2.25	$2.25	$145,238	5, page 7
Concrete Slab	1,720	CY	198	213	$225	$242	$416,240	5, page 7
Concrete Walls	1,370	CY	198	213	$350	$377	$516,490	5, page 7
Reinforcing Steel	616,000	LBS	198	213	$0.60	$0.65	$400,400	5, page 7
Backfill	14,400	CY	181	181	$4.00	$4.00	$57,600	5, page 7
Miscellaneous @ 20%							$3,483,505	
Pump Station (Q=15,000 CFS)	JOB	LS				$59,106,000	$59,106,000	6
SUBTOTAL BOULDIN ISLAND							$260,268,898	
IV. VENICE ISLAND								
Land Acquisition	3,103	AC				$3,000	$9,309,000	3
Levees								
Riprap	817,300	TON	163	181	$15.00	$16.70	$13,648,910	2, page 439
Bedding (6" thick)	231,000	TON	163	181	$14.00	$15.60	$3,603,600	2, page 439
Geotextile (bedding)	5,199,000	SF	163	181	$0.25	$0.28	$1,455,720	2, page 439
Embankment	265,500	CY	163	181	$7.00	$7.80	$2,070,900	2, page 439
Intake Pump Station w/ fish screens (Q=5,000 cfs)	JOB	LS				$80,575,000	$80,575,000	1
Venice-Mandeville Siphon (1700')[b]								
Temporary River Alignment								
Excavation	85,697	CY	181	181	$2.50	$2.50	$214,243	5, page 7
Levees (using excavation)	85,697	CY	181	181	$3.00	$3.00	$257,091	5, page 7
Cofferdam Sheetpiling	527,800	SF	202	207	$28.00	$28.70	$15,147,860	5, page 7
Cofferdam Gravel Fill	51,800	CY	202	207	$21.00	$21.50	$1,113,700	5, page 7
Backfill	85,697	CY	181	181	$4.00	$4.00	$342,788	5, page 7
Dewatering	JOB	LS	202	207	$100,000	$102,500	$102,500	5, page 7
Siphon								
Excavation-Structural	459,000	CY	181	181	$6.00	$6.00	$2,754,000	5, page 7
Concrete	47,600	CY	198	213	$275	$296	$14,089,600	5, page 7
Reinforcing Steel	9,554,000	LBS	198	213	$0.60	$0.65	$6,210,100	5, page 7
Backfill	239,700	CY	181	181	$4.00	$4.00	$958,800	5, page 7
Riprap	73,100	TON	181	181	$27.00	$27.00	$1,973,700	5, page 7

Table 2b
ESTIMATED COSTS
CHAIN OF LAKES PROJECT - SIPHON AND PUMP ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Access Roads	0.46	MI	231	237	$500,000	$513,000	$235,980	5, page 7
Inlet and Outlet Transition								
Excavation	64,550	CY	181	181	$2.25	$2.25	$145,238	5, page 7
Concrete Slab	1,720	CY	198	213	$225	$242	$416,240	5, page 7
Concrete Walls	1,370	CY	198	213	$350	$377	$516,490	5, page 7
Reinforcing Steel	616,000	LBS	198	213	$0.60	$0.65	$400,400	5, page 7
Backfill	14,400	CY	181	181	$4.00	$4.00	$57,600	5, page 7
Miscellaneous @ 20%							$8,987,266	
SUBTOTAL VENICE ISLAND							$164,586,725	
V. MANDEVILLE ISLAND								
Land Acquisition	5,214	AC				$3,000	$15,642,000	3
Levees								
Riprap	953,800	TON	163	181	$15.00	$16.70	$15,928,460	2, page 439
Bedding (6" thick)	269,600	TON	163	181	$14.00	$15.60	$4,205,760	2, page 439
Geotextile (bedding)	6,067,600	SF	163	181	$0.25	$0.28	$1,698,928	2, page 439
Embankment	309,900	CY	163	181	$7.00	$7.80	$2,417,220	2, page 439
Intake Pump Station w/ fish screens (Q=5,000 cfs)	JOB	LS				$80,575,000	$80,575,000	1
Mandeville-Bacon Siphon (900')[b]								
Temporary River Alignment								
Excavation	45,369	CY	181	181	$2.50	$2.50	$113,423	5, page 7
Levees (using excavation)	45,369	CY	181	181	$3.00	$3.00	$136,107	5, page 7
Cofferdam Sheetpiling	226,200	SF	202	207	$28.00	$28.70	$6,491,940	5, page 7
Cofferdam Gravel Fill	22,200	CY	202	207	$21.00	$21.50	$477,300	5, page 7
Backfill	45,369	CY	181	181	$4.00	$4.00	$181,476	5, page 7
Dewatering	JOB	LS	202	207	$100,000	$102,500	$102,500	5, page 7
Siphon								
Excavation-Structural	243,000	CY	181	181	$6.00	$6.00	$1,458,000	5, page 7
Concrete	25,200	CY	198	213	$275	$296	$7,459,200	5, page 7
Reinforcing Steel	5,058,000	LBS	198	213	$0.60	$0.65	$3,287,700	5, page 7
Backfill	126,900	CY	181	181	$4.00	$4.00	$507,600	5, page 7
Riprap	38,700	TON	181	181	$27.00	$27.00	$1,044,900	5, page 7
Access Roads	0.24	MI	231	237	$500,000	$513,000	$123,120	5, page 7
Inlet and Outlet Transition								
Excavation	64,550	CY	181	181	$2.25	$2.25	$145,238	5, page 7
Concrete Slab	1,720	CY	198	213	$225	$242	$416,240	5, page 7
Concrete Walls	1,370	CY	198	213	$350	$377	$516,490	5, page 7
Reinforcing Steel	616,000	LBS	198	213	$0.60	$0.65	$400,400	5, page 7
Backfill	14,400	CY	181	181	$4.00	$4.00	$57,600	5, page 7

Table 2b
ESTIMATED COSTS
CHAIN OF LAKES PROJECT - SIPHON AND PUMP ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Miscellaneous @ 20%							$4,583,847	
Pump Station (Q=15,000 cfs)	JOB	LS				$59,106,000	$59,106,000	6
SUBTOTAL MANDEVILLE ISLAND							$207,076,448	
VI. BACON ISLAND								
Land Acquisition	5,066	AC				$3,000	$15,198,000	
Levees								
Riprap	914,600	TON	163	181	$15.00	$16.70	$15,273,820	2, page 439
Bedding (6" thick)	258,500	TON	163	181	$14.00	$15.60	$4,032,600	2, page 439
Geotextile (bedding)	5,818,200	SF	163	181	$0.25	$0.28	$1,629,096	2, page 439
Embankment	297,100	CY	163	181	$7.00	$7.80	$2,317,380	2, page 439
Intake Pump Station w/ fish screens (Q=5,000 cfs)	JOB	LS				$80,575,000	$80,575,000	1
Bacon-Woodward Siphon (1500')[b]								
Temporary River Alignment								
Excavation	75,615	CY	181	181	$2.50	$2.50	$189,038	5, page 7
Levees (using excavation)	75,615	CY	181	181	$3.00	$3.00	$226,845	5, page 7
Cofferdam Sheetpiling	226,200	SF	202	207	$28.00	$28.70	$6,491,940	5, page 7
Cofferdam Gravel Fill	22,200	CY	202	207	$21.00	$21.50	$477,300	5, page 7
Backfill	75,615	CY	181	181	$4.00	$4.00	$302,460	5, page 7
Dewatering	JOB	LS	202	207	$100,000	$102,500	$102,500	5, page 7
Siphon								
Excavation-Structural	405,000	CY	181	181	$6.00	$6.00	$2,430,000	5, page 7
Concrete	42,000	CY	198	213	$275	$296	$12,432,000	5, page 7
Reinforcing Steel	8,430,000	LBS	198	213	$0.60	$0.65	$5,479,500	5, page 7
Backfill	211,500	CY	181	181	$4.00	$4.00	$846,000	5, page 7
Riprap	64,500	TON	181	181	$27.00	$27.00	$1,741,500	5, page 7
Access Roads	0.41	MI	231	237	$500,000	$513,000	$210,330	5, page 7
Inlet and Outlet Transition								
Excavation	64,550	CY	181	181	$2.25	$2.25	$145,238	5, page 7
Concrete Slab	1,720	CY	198	213	$225	$242	$416,240	5, page 7
Concrete Walls	1,370	CY	198	213	$350	$377	$516,490	5, page 7
Reinforcing Steel	616,000	LBS	198	213	$0.60	$0.65	$400,400	5, page 7
Backfill	14,400	CY	181	181	$4.00	$4.00	$57,600	5, page 7
Miscellaneous @ 20%							$6,493,076	
SUBTOTAL BACON ISLAND							$157,984,352	
VII. WOODWARD ISLAND								
Land Acquisition	1,565	AC				$3,000	$4,695,000	3
Levees								

Table 2b
ESTIMATED COSTS
CHAIN OF LAKES PROJECT - SIPHON AND PUMP ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Riprap	561,600	TON	163	181	$15.00	$16.70	$9,378,720	2, page 439
Bedding (6" thick)	158,800	TON	163	181	$14.00	$15.60	$2,477,280	2, page 439
Geotextile (bedding)	3,572,400	SF	163	181	$0.25	$0.28	$1,000,272	2, page 439
Embankment	182,500	CY	163	181	$7.00	$7.80	$1,423,500	2, page 439
Intake Pump Station w/ fish screens (Q=5,000 cfs)	JOB	LS				$80,575,000	$80,575,000	1
Woodward-Victoria Siphon (700')[b]								
Temporary River Alignment								
Excavation	35,287	CY	181	181	$2.50	$2.50	$88,218	5, page 7
Levees (using excavation)	35,287	CY	181	181	$3.00	$3.00	$105,861	5, page 7
Cofferdam Sheetpiling	150,800	SF	202	207	$28.00	$28.70	$4,327,960	5, page 7
Cofferdam Gravel Fill	14,800	CY	202	207	$21.00	$21.50	$318,200	5, page 7
Backfill	35,287	CY	181	181	$4.00	$4.00	$141,148	5, page 7
Dewatering	JOB	LS	202	207	$100,000	$102,500	$102,500	5, page 7
Siphon								
Excavation-Structural	189,000	CY	181	181	$6.00	$6.00	$1,134,000	5, page 7
Concrete	19,600	CY	198	213	$275	$296	$5,801,600	5, page 7
Reinforcing Steel	3,934,000	LBS	198	213	$0.60	$0.65	$2,557,100	5, page 7
Backfill	98,700	CY	181	181	$4.00	$4.00	$394,800	5, page 7
Riprap	30,100	TON	181	181	$27.00	$27.00	$812,700	5, page 7
Access Roads	0.19	MI	231	237	$500,000	$513,000	$97,470	5, page 7
Inlet and Outlet Transition								
Excavation	64,550	CY	181	181	$2.25	$2.25	$145,238	5, page 7
Concrete Slab	1,720	CY	198	213	$225	$242	$416,240	5, page 7
Concrete Walls	1,370	CY	198	213	$350	$377	$516,490	5, page 7
Reinforcing Steel	616,000	LBS	198	213	$0.60	$0.65	$400,400	5, page 7
Backfill	14,440	CY	181	181	$4.00	$4.00	$57,760	5, page 7
Miscellaneous @ 20%							$3,483,537	
Pump Station (Q=15,000 cfs)	JOB	LS				$59,106,000	$59,106,000	6
SUBTOTAL WOODWARD ISLAND							$179,556,993	
VIII. VICTORIA ISLAND								
Land Acquisition	6,767	AC				$3,000	$20,301,000	3
Levees								
Riprap	973,500	TON	163	181	$15.00	$16.70	$16,257,450	2, page 439
Bedding (6" thick)	275,200	TON	163	181	$14.00	$15.60	$4,293,120	2, page 439
Geotextile (bedding)	6,192,500	SF	163	181	$0.25	$0.28	$1,733,900	2, page 439
Embankment	316,200	CY	163	181	$7.00	$7.80	$2,466,360	2, page 439
Bridge	21,000	SF				$100	$2,100,000	1

Table 2b
ESTIMATED COSTS
CHAIN OF LAKES PROJECT - SIPHON AND PUMP ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Elevated Roadway (Highway 4)								
Riprap	570,200	TON	163	181	$15.00	$16.70	$9,522,340	2, page 439
Bedding (6" thick)	161,200	TON	163	181	$14.00	$15.60	$2,514,720	2, page 439
Geotextile (bedding)	3,627,500	SF	163	181	$0.25	$0.28	$1,015,700	2, page 439
Embankment	819,800	CY	163	181	$7.00	$7.80	$6,394,440	2, page 439
Foundation	740,100	CY	163	181	$9.80	$10.90	$8,067,090	
Aggregate Base	14,980	TON				$19.15	$286,867	4, item v-d
Asphalt Concrete	6,810	TON				$58.92	$401,245	4, item v-e
Intake Pump Station w/ fish screens (Q=5,000 cfs)	JOB	LS				$80,575,000	$80,575,000	1
Victoria-CCFB Siphon (1400')[b]								
Temporary River Alignment								
Excavation	70,574	CY	181	181	$2.50	$2.50	$176,435	5, page 7
Levees (using excavation)	70,574	CY	181	181	$3.00	$3.00	$211,722	5, page 7
Cofferdam Sheetpiling	150,800	SF	202	207	$28.00	$28.70	$4,327,960	5, page 7
Cofferdam Gravel Fill	14,800	CY	202	207	$21.00	$21.50	$318,200	5, page 7
Backfill	70,574	CY	181	181	$4.00	$4.00	$282,296	5, page 7
Dewatering	JOB	LS	202	207	$100,000	$102,500	$102,500	5, page 7
Siphon								
Excavation-Structural	410,200	CY	181	181	$6.00	$6.00	$2,461,200	5, page 7
Concrete	42,000	CY	198	213	$275	$296	$12,432,000	5, page 7
Reinforcing Steel	8,514,800	LBS	198	213	$0.60	$0.65	$5,534,620	5, page 7
Backfill	212,800	CY	181	181	$4.00	$4.00	$851,200	5, page 7
Riprap	64,400	TON	181	181	$27.00	$27.00	$1,738,800	5, page 7
Access Roads	0.41	MI	231	237	$500,000	$513,000	$210,330	5, page 7
Inlet and Outlet Transition								
Excavation	67,480	CY	181	181	$2.25	$2.25	$151,830	5, page 7
Concrete Slab	1,800	CY	198	213	$225	$242	$435,600	5, page 7
Concrete Walls	1,430	CY	198	213	$350	$377	$539,110	5, page 7
Reinforcing Steel	644,000	LBS	198	213	$0.60	$0.65	$418,600	5, page 7
Backfill	15,040	CY	181	181	$4.00	$4.00	$60,160	5, page 7
Radial Gates and Hoist Assemblies	2	EA				$255,000	$510,000	
Miscellaneous @ 20%							$6,152,513	
Victoria Island Pumping Plant (Q=15,000 cfs)	JOB	LS				$59,106,000	$59,106,000	
SUBTOTAL VICTORIA ISLAND							$251,950,308	
IX. SEEPAGE INTERCEPTION WELLS	JOB	LS				$13,927,000	$13,927,000	1
X. CVP-SWP IMPROVEMENTS								
Fish Screen Improvements at Skinner Fish Facility	10,400	CFS				$10,000	$104,000,000	1

Table 2b
ESTIMATED COSTS
CHAIN OF LAKES PROJECT - SIPHON AND PUMP ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Interconnection Canal to Delta Mendota Canal:								
Excavation	375,000	CY				$2.00	$750,000	1
Compacted Embankment	486,000	CY				$0.80	$388,800	1
Common Embankment	203,000	CY				$0.50	$101,500	1
Borrow	557,000	CY				$5.00	$2,785,000	1
Intake Structure with Radial Gates From Clifton Court For	JOB	LS				$9,135,000	$9,135,000	1
Radial Gate Structure on Delta Mendota Canal	JOB	LS				$6,798,000	$6,798,000	1
Fish Screens Tracy Pumping Plant	4,500	CFS				$10,000	$45,000,000	1
SUBTOTAL CVP-SWP IMPROVEMENTS							$168,958,300	
SUBTOTAL COST ITEMS FOR CHAIN OF LAKES - SIPHON AND PUMP ALTERNATIVE							1,776,400,000	
CONTINGENCIES @ 20%							$355,300,000	
ESTIMATED CONSTRUCTION COST							$2,131,700,000	
ENGR., LEGAL, AND ADMIN. @ 35%							$746,100,000	
ESTIMATED CAPITAL COST							$2,877,800,000	
ESTIMATED CAPITAL COST RANGE								
LOW (-10 %)							$2,590,000,000	
HIGH (+25%)							$3,597,000,000	

Footnotes:

[a] SF=square foot; LS=lump sum; CY=cubic yard; AC=acre; CFS=cubic feet per second; HP=horsepower; LBS=pound; MI=mile; EA=each.

[b] The USBR index date for all siphons is September 95, not the October 1990 date shown above.

Cost References:

1. Cost developed by Bookman-Edmonston Engineering.
2. California Department of Water Resources, *North Delta Program Draft EIR, EIS*, November 1990.
3. U.S. Bureau of Reclamation, Land Resources Branch, Graham McMullen, February 1997.
4. California Department of Water Resources, *Los Banos Grandes Facilities Report, Appendix A: Designs and Cost Estimates, December 1990.*
5. California Department of Water Resources, *Isolated Transfer Facility Cost Estimate*, September 1995.
6. U.S. Bureau of Reclamation, *Reconnaissance Estimate, Delta Division--Peripheral Canal*, October 1964.

Table 3
SUMMARY OF ESTIMATED COSTS
CHAIN OF LAKES PROJECT

Cost Item	Estimated Costs ($Million)	
	Siphon Only Alternative	Siphon and Pump Alternative
Delta Cross Channel Enlargement	190.0	190.0
Tyler Island Conversion	215.5	182.0
Bouldin Island Conversion	223.1	260.3
Venice Island Conversion	209.9	164.6
Mandeville Island Conversion	173.0	207.1
Bacon Island Conversion	203.0	158.0
Woodward Island Conversion	142.4	179.6
Victoria Island Conversion	292.0	251.9
Seepage Interception Wells	13.9	13.9
CVP-SWP Improvements	169.0	169.0
SUBTOTAL	**1,831.8**	**1,776.4**
Contingencies (20%)	366.4	355.3
ESTIMATED CONSTRUCTION COST	2,198.2	2,131.7
Engineering, Legal, and Project Administration (35%)	769.4	746.1
ESTIMATED TOTAL CAPITAL COST	**2,967.6**	**2,877.8**
CAPITAL COST RANGE (minus 10% - plus 25%)	**2,671 - 3,710**	**2,590 - 3,597**

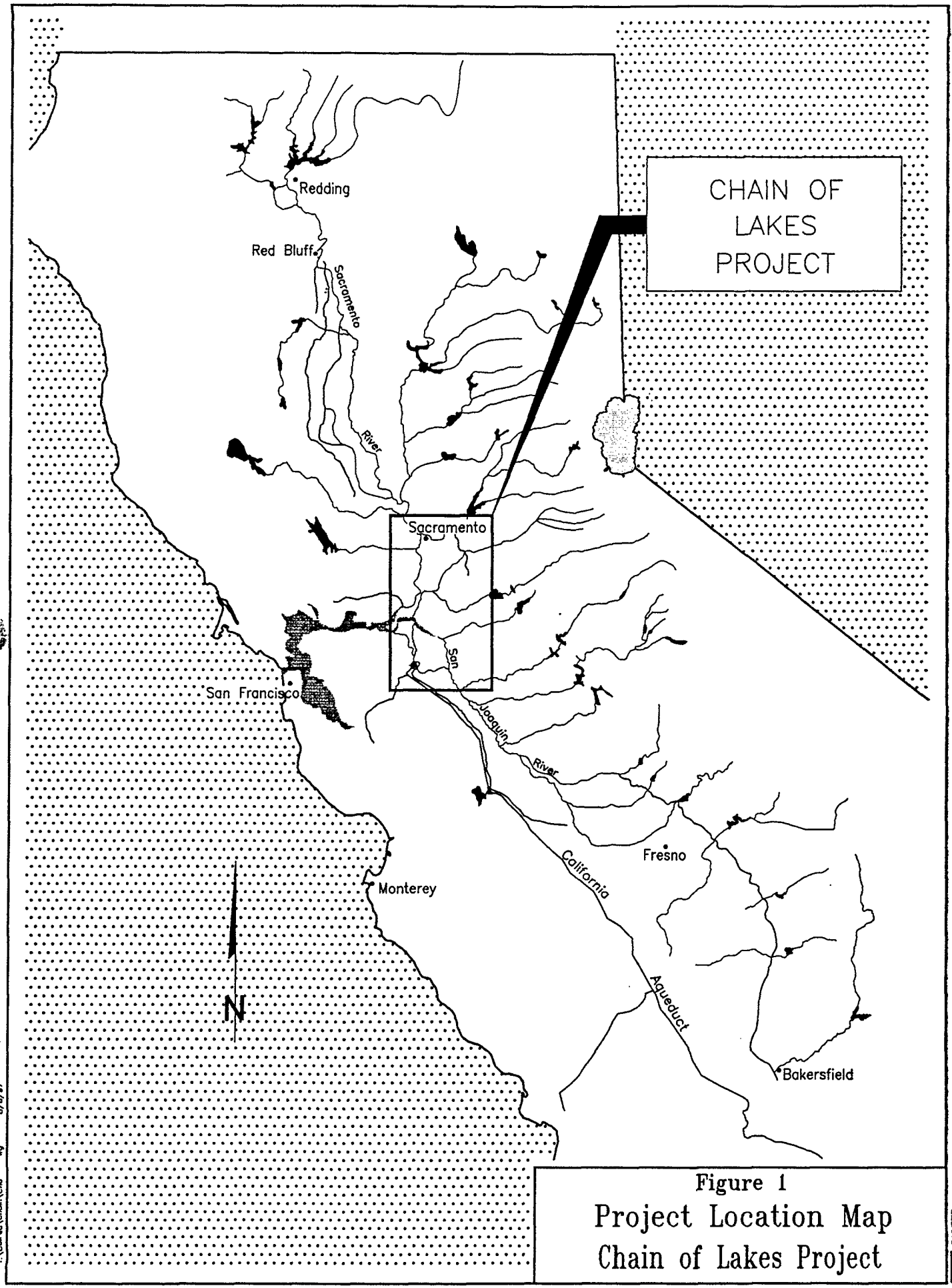

Figure 1
Project Location Map
Chain of Lakes Project

CALFED BAY-DELTA PROGRAM

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ENLARGE DELTA CROSS CHANNEL WITH ADDITIONAL GATES, FISH SCREENS & 10,000 CFS PUMPING PLANT

SETBACK LEVEE

ELEVATED ROADWAY

ELEVATED ROADWAY

INTERCONNECTION

SACRAMENTO DEEP WATER SHIP CHANNEL

YOLO BYPASS

SACRAMENTO RIVER

MOKELUMNE RIVER

COSUMNES RIVER

SAN JOAQUIN RIVER

OLD RIVER

MIDDLE RIVER

NORTH BAY AQUEDUCT

SOUTH BAY AQUEDUCT

DELTA MENDOTA CANAL

CALIFORNIA AQUEDUCT

SAN JOAQUIN

LODI

STOCKTON

TRACY

SACRAMENTO

Galt

Freeport

Hood

Clarksburg

Isleton

Rio Vista

Byron

Brentwood

ANTIOCH

PITTSBURG

Stone Lake

Merritt Island

Pierson District

Grand Island

Sutter Island

Ryder Island

Hastings Tract

New Hope Tract

Canal Ranch Tract

Brack Tract

Terminous Tract

Staten Island

Tyler Island

Boulkin Island

Empire Tract

Venice Island

Medford Island

McDonald Island

Mandeville Island

Bacon Island

Quimby Island

Shin Kee Tract

Rio Blanco Tract

Bishop Tract

Shima Tract

King Island

Rindge Tract

Lower Roberts Island

Lower Jones Tract

Upper Jones Tract

Middle Roberts Island

Upper Roberts Island

Union Island

Stewart Tract

Fabian Tract

Woodwards Island

Victoria Island

Coney Island

Clifton Court Forebay

Tracy Pumping Plant

Harvey O. Banks Pumping Plant

South Bay Pumping Plant

Webb Tract

Franks Tract

Holland Tract

Palm Tract

Orwood Tract

Byron Tract

Bethel Tract

Hotchkiss Tract

Brannan Island

Twitchell Island

Bradford Island

Jersey Island

Webb Tract

Decker Island

Sherman Island

Browns Island

Van Sickle Island

Chipps Island

Project Location

REDDING

SACRAMENTO

SAN FRANCISCO

LOS ANGELES

VICINITY MAP

N

0 1 2 4

MILES

Figure 2
Facility Location Map
Chain of Lakes Project

LEGEND

- Sacramento, San Joaquin, & Mokelumne Rivers
- Delta Waterways
- Proposed Chain of Lakes
- Existing Roads and Highways
- Existing Canals
- Existing Rivers & Creeks
- New Levee
- Reinforce Existing Levee
- Siphon
- Pumping Plant

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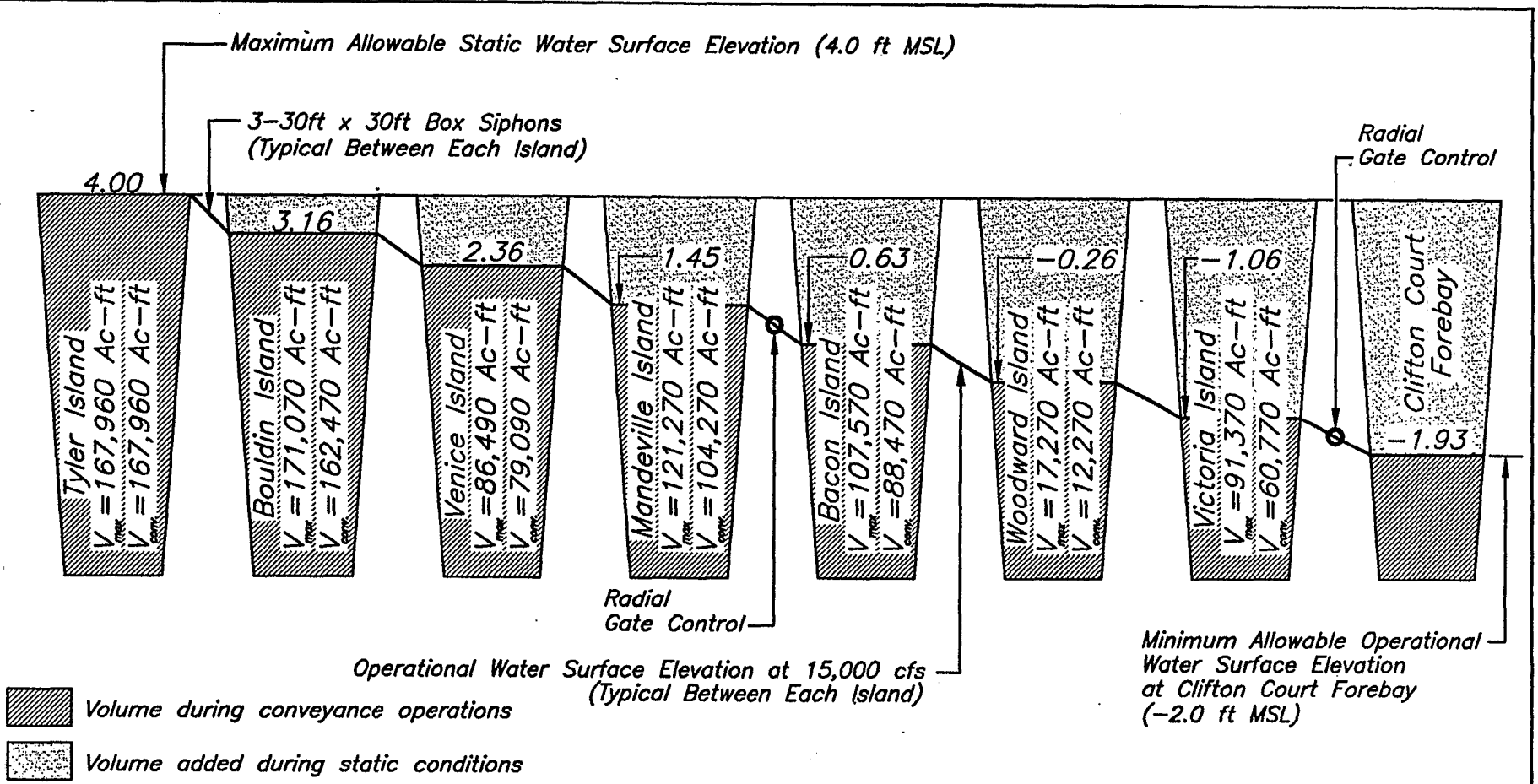

NOTES:

1. Levee elevations to be raised accordingly such that the static water surface elevation in all reservoirs is 4.0 feet MSL.
2. $V_{conv.}$ = Maximum storage capacity while conveying 15,000 cfs through the entire system. = 675,300 Ac-ft
3. V_{max} = Maximum static storage capacity of island. = 763,000 Ac-ft

Figure 3
Water Surface Elevation Profile
Chain of Lakes
Siphon Only Alternative

CALFED BAY-DELTA PROGRAM

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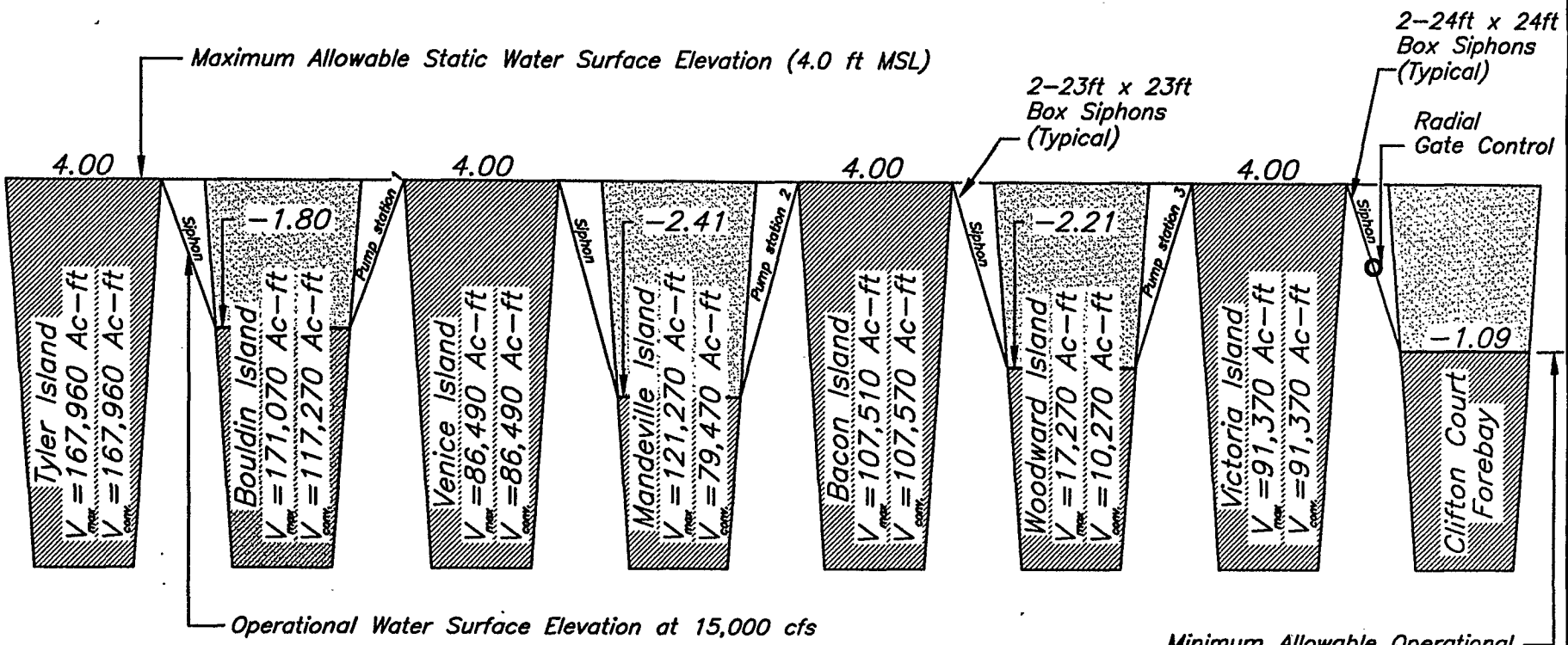

NOTES:

1. Levee elevations to be raised accordingly such that the static water surface elevation in all reservoirs is 4.0 feet MSL.
2. $V_{conv.}$ = Maximum storage capacity while conveying 15,000 cfs through the entire system. = 660,400 Ac-ft
3. V_{max} = Maximum static storage capacity of island. = 763,000 Ac-ft

Figure 4

Water Surface Elevation Profile

Chain of Lakes

Pump and Siphon Alternative

CALFED BAY-DELTA PROGRAM

D-008786

FACILITY DESCRIPTIONS AND UPDATED COST ESTIMATES FOR AN IN-DELTA STORAGE PROJECT

Prepared by the CALFED Storage and Conveyance Refinement Team
October 1997

D-008787

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Figure 1 Project Location Map — In-Delta Storage Project

Figure 2 Facilities Location Map — In-Delta Storage Project — Alternative A

Figure 3 Facilities Location Map — In-Delta Storage Project — Alternative B

INTRODUCTION

The *Facility Descriptions and Updated Cost Estimates for an In-Delta Storage Project* has been prepared as part of the Storage and Conveyance Component Refinement Task of the CALFED Bay-Delta Program (CALFED or Program). CALFED's mission is to develop a long-term comprehensive plan that will restore the ecological health and improve water management for beneficial uses of the San Francisco Bay/Sacramento-San Joaquin Delta (Bay-Delta) system.

This report summarizes the principal features, estimated costs, and environmental considerations of an In-Delta Storage Project. An In-Delta Storage Project would create an isolated storage facility for surplus Sacramento-San Joaquin Delta (Delta) flows from three Delta islands: Bacon, Woodward, and Victoria Islands. The general location of an In-Delta Storage Project is shown on Figure 1. Two alternative configurations have been evaluated within this report. The first alternative would maintain each of the three islands as separate storage compartments joined by siphons beneath the man-made Delta channels currently separating them. The second alternative would join the three islands into a single storage compartment, eliminating the need for siphons. Both alternatives include improvement to Central Valley Project (CVP) and State Water Project (SWP) Delta pumping facilities.

This evaluation and others being performed by CALFED are intended to provide facilities descriptions and cost estimates of representative storage and conveyance components. The objectives of the In-Delta Storage Project evaluation are to (1) provide a cost estimate for the project which represents costs within the range expected if the project were to be constructed today and (2) enable CALFED to compare this project against other projects that might be considered as part of a long-term CALFED solution strategy.

The In-Delta Storage Project is a relatively new concept. The alternative configurations of the In-Delta Storage Project, as they are presented within this evaluation, have not been previously studied in detail. The cost estimates for these projects were developed primarily by Bookman-

Edmonston Engineering and CALFED staff. Development of the cost estimate was aided by reviewing and incorporating cost items found in previous reports including the 1990 California Department of Water Resources (DWR) report titled *North Delta Program Draft EIR/EIS* and the 1995 DWR report titled *Isolated Transfer Facility Cost Estimate.*

A preliminary evaluation of the environmental considerations associated with an In-Delta Storage Project has also been included in this report. Fish, wildlife, plant, and cultural resources that could be affected have been described and potential impacts have been identified. The information for evaluation of environmental considerations was gathered from existing literature and databases.

PROJECT BACKGROUND

Reclamation of Delta marshlands began in the 1850s and by the 1930s nearly all of the Delta had been reclaimed into intensively farmed islands. Since then, there have been numerous studies on salinity intrusion control, water quality improvement, and overall management of the water resources in the Delta, including various water storage and conveyance concepts.

The concept of in-Delta storage is relatively new. Over the past several years, several studies have been completed for similar concepts that would flood Delta islands to provide water storage. However, a review of the DWR and the U.S. Bureau of Reclamation (Reclamation) libraries and publications revealed no detailed previous investigations of in-Delta storage facilities by these agencies.

An In-Delta Storage Project concept is a similar and smaller version of the "Chain of Lakes" project, which has been evaluated by CALFED. The Chain of Lakes Project has been identified and discussed in three previous reports: the March 1997 CALFED technical studies report titled *Status Reports on Technical Studies for the Storage and Conveyance Refinement Process*, the February 1997 *Preliminary Working Draft CALFED Bay-Delta Program Storage and*

D-008791

Conveyance Component Inventories, and the August 1997 draft *Facility Descriptions and Updated Cost Estimates for the Chain of Lakes Project*. Delta storage and conveyance concepts have been considered in the CALFED process as potential components of a long-term comprehensive plan that will restore the ecological health and improve water management of the Bay-Delta. This evaluation builds on that concept and provides CALFED with a cost estimate and written description of two alternative In-Delta Storage Project configurations that can be compared to other projects, including the Chain of Lakes Project, for consideration as a component of a long-term CALFED solution strategy.

FACILITIES DESCRIPTION

This section provides an overview of the major features included in the two alternative In-Delta Storage Project configurations. The conceptual design of the alternative In-Delta Storage Projects are based on original work developed by Bookman-Edmonston Engineering and CALFED staff.

PROJECT LOCATION

The In-Delta Storage Project would be located in the Delta along the western border of San Joaquin County. The project would convert three Delta islands — Bacon, Woodward, and Victoria Islands — into storage facilities. These islands are bordered on the west by Old River and on the east by Middle River. The southwest end of Victoria Island is adjacent to Clifton Court Forebay. Figure 2 provides a detailed facilities location map for the In-Delta Storage Project — Alternative A; maintaining three separate island storage compartments. Figure 3 provides a detailed facilities location map for the In-Delta Storage Project — Alternative B; a single storage compartment created by joining the three islands.

PROJECT DESCRIPTION

The In-Delta Storage Project is a combined isolated storage and conveyance facility that would store surplus Delta flows and convey stored water to Clifton Court Forebay for use by either the SWP or the CVP without reintroducing the stored water to Delta channels. The in-Delta storage system would be hydraulically isolated from Delta's channels and would be connected to Clifton Court Forebay via siphons beneath Old River from Victoria Island, allowing the storage project to operate as an extension of Clifton Court Forebay. In addition, each of the two alternative project configurations would have three new intake pumping stations that could substantially increase SWP and CVP operational flexibility to reduce impacts to Delta fisheries and to improve the water quality of Delta exports. Improvements to CVP and SWP Delta pumping facilities would add additional operational flexibility and further improve existing fish protection facilities.

In-Delta Storage Project — Alternative A

The configuration of the In-Delta Storage Project — Alternative A would maintain Bacon, Woodward, and Victoria Islands as separate Delta-island storage facilities connected by siphons beneath the Delta channels that currently separate the islands. This chain of three Delta-island storage facilities would be connected to Clifton Court Forebay via siphons and a pumping plant. The pumping plant would enable maximum utilization of the storage capacity of three islands by allowing water stored in the islands to be pumped into Clifton Court Forebay when the water surface elevation in three storage islands is below that of Clifton Court Forebay.

The principle facilities of Alternative A include siphon connections between Bacon and Woodward Islands and Woodward and Victoria Islands with capacities of 5,000 cfs, a screened intake pumping station on Bacon Island, two screened intake pumping stations on Victoria Island, and a siphon connection from Victoria Island to Clifton Court Forebay with a 15,000 cfs capacity, including a pumping plant and a radial gate control structure. The improvements to the

CVP and SWP Delta pumping facilities would include a new interconnection between Clifton Court Forebay and the Delta-Mendota Canal, as well as upgrading the fish screening facilities at the Skinner Delta Fish Protection Facility and at the Tracy Pumping Plant. The combined storage capacity of the three islands would be 216,210 acre-feet based on a maximum allowable water surface elevation of 4.0 feet above mean sea level (MSL). A summary of the physical characteristics of Alternative A is presented in Table 1 and the locations of the facilities associated with this alternative are shown in Figure 2. The following sections provide a description of the In-Delta Storage Project — Alternative A.

Bacon Island

Bacon Island would be converted from its present uses, primarily agriculture, to an island storage facility. The island would store a maximum of 107,570 acre-feet at a maximum water surface elevation of 4.0 feet above MSL. Much of the interior of Bacon Island is 15 feet below sea level. Approximately 14 miles of levees would be reinforced to accommodate water storage on the island's interior.

The Bacon Island Storage facility would include a screened 5,000 cfs capacity low-lift pump station located on the northeastern corner of Bacon Island. The pump station would fill Bacon Island with flows from Middle River. The pump station would be an indoor type, housing 11 pumping units, including one standby unit, and would have a total capacity of 7,570 horsepower. The fish screens would be designed and operated with the best available technology.

The siphon connection to Woodward Island would require a 1,500-foot siphon crossing using two concrete box siphons with dimensions of 18' x 18'. To achieve a flow of 5,000 cfs through the siphons to Woodward Island, a head differential between Bacon and Woodward Islands of about 2.3 feet would be required. The siphons would be constructed with 39-inch-thick walls with reinforcing steel of 200 pounds-per-cubic-yard of concrete. The wall thickness is considered adequate to counteract the effects of buoyancy when the siphons are dewatered. The

siphons would be constructed in place and would require the temporary relocation of the man-made Delta channel separating Bacon and Woodward Islands. The invert elevation of the box siphons would be 40 feet below the existing channel bottom. The concrete box siphons would be covered with a 5-foot layer of rip-rap to protect against erosion.

Woodward Island

Woodward Island would have a maximum storage capacity of 17,270 acre-feet at a maximum water surface elevation of 4.0 feet above MSL. Approximately 9 miles of levees would have to be reinforced to allow water storage on the island's interior. Woodward Island would be connected to Bacon Island upstream and Victoria Island downstream. The downstream connection to Victoria Island would require a 700-foot siphon crossing of the man-made Woodward and North Victoria Canals. The siphon connection would be made through two 18' x 18' boxes similar in construction to those described for Bacon Island. To achieve a flow of 5,000 cfs from Woodward Island to Victoria Island; a head differential between the two islands of about 1.9 feet would be required.

The siphon connections between Bacon and Woodward Islands and Victoria and Woodward Islands would be unregulated; therefore, Woodward Island would be filled by gravity from water pumped into either Bacon or Victoria Islands. As available Delta flows are pumped into either Bacon or Victoria Islands, the water would flow freely through the siphons to equalize the water surface elevations of all three islands.

Victoria Island

Victoria Island would be the most downstream Delta-island storage facility in Alternative A. Victoria Island would have a maximum storage capacity of 91,370 acre-feet at a maximum water surface elevation of 4.0 feet above MSL. Approximately 15 miles of levees would have to be reinforced to allow storage on the island's interior. Victoria Island would be connected to

Woodward Island upstream and to Clifton Court Forebay downstream. The downstream connection to Clifton Court Forebay would be made through a 1,400-foot siphon beneath Old River with a conveyance capacity of 15,000 cfs. The connection to Clifton Court Forebay would be made through three 30' x 30' concrete box siphons that would include radial gate control structures and a pumping plant at the siphon outlets to Clifton Court Forebay. The siphon would include a 15,000 cfs pumping facility to maximize the movement of stored water into Clifton Court Forebay.

Two screened intake pumping stations would be located on Victoria Island. One of the intake facilities would be located on the island's northeast side, across from Upper Jones Tract. This intake station would capture available flows from the Middle River for storage in the islands. The other intake station would be located on the island's northwest side, across from Orwood Tract to capture flows of Old River for storage in the islands.

In-Delta Storage Project — Alternative B

The configuration of the In-Delta Storage Project — Alternative B would combine Bacon, Woodward, and Victoria Islands into a single Delta-island storage facility. This would be achieved by removing the man-made channels and their associated levees, separating the three islands. This configuration would eliminate the need to construct siphons connecting the three individual islands as proposed in Alternative A. The construction of siphons in the Delta would offer a significant engineering challenge and would be costly, as indicated in the Cost Estimate section of this report. Alternative B would serve the same function as Alternative A; to provide in-Delta storage capacity, which could be operated as an extension of Clifton Court Forebay and would offer increased operational flexibility from three new Delta diversion locations for CVP and SWP export supplies.

The principle facilities of Alternative B include a screened intake pumping station on Bacon Island, a screened intake pumping station at the east and west end of the North Victoria Canal,

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and a siphon structure connecting the Delta-island storage facility to Clifton Court Forebay, including a pumping plant and radial gates. The physical characteristics of the facilities associated with Alternative B are provided in Table 2 and their locations are shown in Figure 3. The following sections provide a description of the In-Delta Storage Project — Alternative B.

Delta-Island Facility Storage

Alternative B would be a single, continuous storage facility incorporating Bacon, Woodward, and Victoria Islands, as indicated previously. The three islands would be joined by constructing levees to close off the east and west ends of the man-made channel between Bacon and Woodward Islands and the Woodward and North Victoria Canals, which separate Woodward and Victoria Islands. The existing levees of these man-made channels would be removed to allow water to flow from Bacon Island to Victoria and, ultimately, into Clifton Court Forebay. The storage capacity of the Delta-island storage facility would be 219,480 acre-feet with a maximum water surface elevation of 4.0 feet above MSL.

Available Delta flows would be diverted into the Delta-island storage facility through three screened low-lift pumping stations. Each of the pumping stations would have a capacity of 5,000 cfs and would include fish screening facilities incorporating best available technology in facility design and operation. Water stored in the Delta-island storage facility would be conveyed to Clifton Court Forebay through siphons beneath Old River with a capacity of 15,000 cfs.

The siphons would be constructed of three 30' x 30' boxes with a total length of 1,400 feet. The siphons would be constructed in place with 29-inch-thick walls with reinforcing steel of 200 pounds-per-cubic-yard of concrete. This wall thickness is considered adequate to counteract the effects of buoyancy when the siphons are dewatered. The invert elevation of the box siphons would be 40 feet below the existing channel bottom of Old River. The concrete boxes would be covered with a 5-foot layer of rip-rap to protect against erosion.

The siphon structure would include a 15,000 cfs pumping plant, which would enable full utilization of the storage capacity of the Delta-island storage facility. The pumping plant would enable water stored in the island to be pumped into Clifton Court Forebay when water surface elevation of Clifton Court Forebay is higher than that within the Delta-island storage facility. The siphon structure would also include a radial gate facility to further maximize the control of water exchanges between the Delta-island storage facility and Clifton Court Forebay.

Modifications to Bacon, Woodward, and Victoria Islands are briefly described in the following sections.

Bacon Island

The conversion of Bacon Island would require the reinforcement of 12.8 miles of levee and the removal of approximately 1.0 mile of levee. The levee that would be removed is adjacent to the unnamed man-made channel on the island's south perimeter. Cut-off levees would be constructed to close off the east end of the unnamed channel and continue the Bacon Island levee to Woodward Island along Middle River. At the west end of the unnamed channel, a similar cut-off levee would be constructed to join Bacon and Woodward Islands' levees along Old River. The remaining levee between the east and west end cut-off levees would be removed to allow water to flow to Woodward Island.

The intake pumping station on Bacon Island would be located on the island's northeast tip, across from Mandeville Island. This pumping station would divert available Delta flows from Middle River into the Delta-island storage facility. As indicated previously the pumping station would be screened and would incorporate the best available technology for fish screens.

Woodward Island

The conversion of Woodward Island into a Delta-island storage facility would require the reinforcement of 5.5 miles of levee and the removal of approximately 3.0 miles of levee. The levees that would be reinforced would generally be on the island's east and west sides. The levees on the island's north side, across from Bacon Island, would be removed to allow water stored on Bacon Island to enter Woodward Island. Similarly, the levee on the south side of Woodward Island would be removed adjacent to Woodward Canal. Removal of this levee would allow water from Bacon and Woodward Islands to enter Victoria Island. Two cut-off levees would be constructed at the east and west ends of Woodward and North Victoria Canals, which would continue the Woodward Island levees to Victoria Island. The cut-off levees would also house the two screened intake pumping plants. These low-lift pumping plants would be similar in design to the intake pumping plant on Bacon Island.

Victoria Island

Victoria Island would be converted into a Delta-island storage facility by removing approximately 2.0 miles of levee on the island's north side and reinforcing the remaining 12.7 miles of levee on the island's east, west, and south sides. The levee that would be removed is adjacent to the North Victoria Canal. Removal of this levee would allow flows to enter Victoria Island from Bacon and Woodward Islands. The siphon and pumping plant connection to Clifton Court Forebay would be located at the southern end of Victoria Island.

SWP and CVP Delta Pumping Facility Improvements

The Skinner Delta Fish Protective Facility, which screens diversions for the SWP's Banks Pumping Plant, would be upgraded with best available technology for fish screens. The new screens would be designed under the guidance of State and federal regulating agencies. An interconnection between Clifton Court Forebay and lower portion of the Delta-Mendota Canal

would also be constructed on the south side of the forebay. This interconnection would allow water stored in Clifton Court Forebay or in either alternative of the In-Delta Storage Project to be diverted to the CVP's Tracy Pumping Plant for pumping and delivery to the Delta-Mendota Canal. The interconnection would be gated to maximize the operational flexibility of the system. An additional gate would be constructed on the Delta-Mendota Canal just downstream of the interconnection. The gate on the Delta-Mendota Canal would enable flows to be released into the Delta-Mendota Canal from Clifton Court Forebay during low tide conditions. The existing fish screens associated with the Tracy Pumping Plant would be upgraded with best available technology screens similar to those that would be installed at the Skinner facility.

COST ESTIMATE

The In-Delta Storage Project is a relatively new project that has not been previously studied. Therefore, no specific previous information describing or estimating the cost of the project was available to serve as a basis for the cost estimate in this report. There are, however, some studies with similar components from which comparative costs can be derived. The cost estimate for the In-Delta Storage Project was developed primarily by Bookman-Edmonston Engineering and Calfed staff and was based on applicable portions of previous studies, experience, and engineering judgment. These previous studies include the 1990 DWR report titled *North Delta Program Draft EIR/EIS* and the 1995 DWR report titled *Isolated Transfer Facility Cost Estimate.*

COST ESTIMATE METHODOLOGY

General

The estimated capital cost of the In-Delta Storage Project was determined by applying current unit costs to quantities developed by Bookman-Edmonston Engineering. Some of the costs used to update this cost estimate were determined by escalating the unit cost to October 1996 dollars

using Reclamation's Construction Cost Trends (CCT) indices. Additional unit costs were developed by Bookman-Edmonston Engineering based on engineering and construction experience. The cost estimate does not include the cost of environmental documentation, environmental mitigation, operation and maintenance, power, and interest during construction.

Tables 2a and 2b provide a detailed breakdown of the estimated capital cost of the In-Delta Storage Project — Alternative A and Alternative B, respectively. Cost items identified in previous cost estimates have been provided, along with the unit cost of the items or an indication that the estimated cost has been developed through a lump sum approach. The tables also include Reclamation's CCT index for the month and year in which the estimated cost was developed and for October 1996. These Reclamation cost indices are used to factor the previous cost estimate to October 1996 dollars. In some instances, only a unit cost has been provided with no cost indices. In these cases, the unit cost has been taken from other sources. The far right-hand column of Table 2 provides the cost reference for each cost item.

Pumping Plants

The cost estimate for the Pumping Plants associated with the In-Delta Storage Project has been based on the cost and quantities from the September 1995 DWR report titled *Isolated Transfer Facility Cost Estimate*. These costs were originally priced in July 1995 dollars and have been updated to October 1996 dollars using the CCT indices described above.

Right-of-Way Costs

Right-of-way costs of $3,000 per acre were used based upon personal communication with Reclamation's Division of Land Resources staff in February 1997. The right-of-way necessary for the development of the In-Delta Storage Project — Alternative A would require 13,398 acres for the three Delta islands in the system. The resulting right-of-way cost of $40.2 million comprises approximately 5 percent of the total estimated capital cost of this alternative. The

right-of-way necessary for the development of Alternative B would require 13,614 acres, resulting in a right-of-way cost of $40.8 million. The right-of-way cost in Alternative B comprises approximately 6 percent of the estimated project cost of this alternative.

Contingencies and Other Costs

All contingencies and engineering, construction management, and administrative factors were determined by engineering judgement based on similar level of cost estimation. Contingencies were chosen to be 20 percent; engineering, construction management, and administration were chosen to be 35 percent. A cost range was developed for the project by subtracting 10 percent from the estimated capital cost for the low-end cost and adding 25 percent to the estimated capital cost for the high-end cost.

PRELIMINARY COST FINDINGS

The estimated costs of Alternative A and B of the In-Delta Storage Project and their supporting facilities have been developed to an October 1996 basis as described above. Table 3 summarizes estimated costs of the major items associated with Alternative A and B. The estimated cost of developing Alternative A of the In-Delta Storage Project would be $982 million with a calculated cost range of $884 to $1,228 million. The cost of constructing the siphons between Bacon and Woodward Islands and Woodward and Victoria Islands would be about $44.3 million or about 5 percent of the estimated project cost.

The estimated project costs of developing Alternative B, the single in-Delta island storage configuration, would be about $800 million with a calculated cost range of $720 to $1,000 million. The estimated cost of removing the channels that separate Bacon and Woodward Islands and Woodward and Victoria Islands is about $10.3, or 1 percent of the project cost.

ENVIRONMENTAL DOCUMENTATION

[NOTE: The Environmental Considerations section needs to be reevaluated by DWR to ensure consistency with the information presented in the previous section.]

This portion of the report provides a summary of environmental considerations related to the proposal for developing a proposed In-Delta Storage Project. Under this proposal, Webb Tract and Bacon Island would be used as year-round water supply reservoirs. Bouldin Island and Holland Tract would be dedicated to wetland and wildlife habitat uses. Fish, wildlife, plant, and cultural resources that could be affected by the In-Delta Storage Project are described and the extent of the impacts is identified. The information presented in this section was gathered from existing literature, with limited original research. No field work was conducted for this analysis.

WILDLIFE

Using Bouldin Island and Holland Tract for wetland and wildlife purposes will have a positive effect on wildlife species. Diverting and storing water on Webb Tract and Bacon Island could result in increased water temperature and reduced water quality in the Delta. Reversed flows would also occur when water is being diverted. In addition to problems associated with reversed flows, migrating fish could be impacted by increased predation and entrainment at the diversion fish screens.

Fish, Amphibians, Reptiles, and Invertebrates

The In-Delta Storage Project would be located adjacent to several waterways that support both anadromous and resident game and non-game fish. Permanent residents or fish dependant on the Delta as a migration corridor or nursery include striped bass, chinook salmon, steelhead trout, American shad, sturgeon, catfish, largemouth bass, winter-run chinook salmon, delta smelt, Sacramento splittail, and numerous other marine and freshwater species.

Depending on outflow regimes and water year hydrology, the Delta supports several types of habitats including estuary, freshwater, and marine water environments. The Delta supports about 90 species of fish. Increased flows of water into the central Delta, to be used for island storage, would draw migrating fish into the area. This longer route between the Bay Area and the upper reaches of the rivers would expose the fish to increased predation, higher temperatures, and more agricultural water diversions. More complex channel configurations and increased reversed flows through the central Delta increase the migrating fish's difficulty in finding their way to the sea or into the main river channels to move upstream.

General Wildlife

Lands within the area of the In-Delta Storage Project are highly cultivated and support a diverse wildlife. Important groups of wildlife dependant on the Delta environment are waterfowl and other migratory birds, game birds such as pheasant and quail, furbearers, and numerous non-game birds and mammals. The Delta is particularly important to waterfowl migrating via the Pacific Flyway. The principal attraction for waterfowl is winter flooded agricultural fields, mainly cereal crops, which provide food and extensive seasonal wetlands. Small mammals find suitable habitat in the Delta and upland areas. Vegetated levees, remnants of riparian forest, and undeveloped islands provide habitat for numerous small mammals. Small mammal species include muskrat, mink, river otter, beaver, raccoon, gray fox, and skunks. A variety of non-game wildlife such as songbirds, hawks, owl, reptiles, and amphibians can also be found in the area.

Sensitive and Listed Fish and Wildlife Species

Listed wildlife species that have been recorded in or around the area that would be directly affected by the In-Delta Storage Project include Swainson's hawk and California black rail (State threatened [ST]), and San Joaquin kit fox (federal endangered [FE], ST). Other listed species that could potentially be affected by the proposal include American peregrine falcon (FE), Aleutian Canada goose (federal threatened [FT]), bald eagle (FT, State endangered [SE]), giant

garter snake (ST), winter-run chinook salmon (FE), delta smelt (FT), longhorn fairy shrimp (FE), vernal pool fairy shrimp (FT), vernal pool tadpole shrimp (FE), valley elderberry longhorn beetle (FT), and Delta green ground beetle (FT).

Wildlife species that are either candidates for State or federal listing or considered species of special concern by the California Department of Fish and Game (CDFG) that have been known to occur in or near the area affected by the proposed In-Delta Storage Project include the great blue heron and the western pond turtle (federal candidate, CDFG species of special concern).

Bald eagle, peregrine falcon, yellow-billed cuckoo, and Aleutian Canada goose have been observed in the Delta, but none are confined exclusively to the area.

Sightings of San Joaquin kit fox have been made in the foothills south and west of the Clifton Court Forebay. It is unlikely that the In-Delta Storage Project will have a direct effect on this species.

Although there have been limited sightings of the giant garter snake in the project area, suitable habitat consisting of marsh and streambed vegetation is widespread in the area. Areas of suitable habitat include vegetated levees, vegetated islands and mid-channel berms, and vegetated irrigation canals and drains within agricultural lands. Virtually all islands and channels contain some suitable habitat for this species.

VEGETATION

Because of the intensive nature of farming activities on the islands, only about 1 percent of the lands in the project area are riparian. The majority of the riparian habitat in the project area can be found on Holland and Webb Tracts. Riparian habitat types in the area consist of cottonwood-willow woodland and willow scrub. The riparian habitat found here is generally young (less than five years) and can be found in small linear strips along ditches or at the toes of the perimeter

levees that have not been regularly maintained. Maintenance policies of the local reclamation districts do not allow mature woody vegetation on the upper interior levee slopes or on exterior levee faces because of the need to inspect the levees for seepage and structural defects.

Annual grasslands occur primarily on the broad, gentle interior slopes of the perimeter levees and account for approximately 7 percent of the lands within the project area. Levees may be grazed but are not cultivated. A portion of the grasslands are upland habitat, which occurs on remnant knolls or sand hills on Webb and Holland Tracts.

Less than 2 percent of the lands affected by the In-Delta Storage Project are occupied by structures, paved roads, or scarified and compacted soil. The largest portion of scarified and compacted soil is a site for processing and storing pulp byproduct used as a soil amendment on Holland Tract.

Sensitive and Listed Plant Species

A federal candidate/State-listed rare plant, Mason's lilaeopsis, has been known to occur in or around the area that could be affected by the In-Delta Storage Project. An additional species, Antioch dunes evening-primrose (federal endangered), could also be impacted if found in the area.

Sensitive plant species or plants that are candidates for federal or State listing that could possibly be found in the project area include Suisun marsh aster, caper-fruited tropidocarpum, Delta tule pea, heartscale, and valley spearscale.

Additional plants listed by the California Native Plant Society as being rare, threatened, or endangered in California and elsewhere that could also be affected by the In-Delta Storage Project include marsh skullcap, California hibiscus, Delta mudwort, and bristly sedge.

A special-status habitat that may be found along or near the area of the proposed project is the coastal and valley freshwater marsh. Also, there are four significant natural areas within or adjacent to the area affected by the In-Delta Storage Project: Middle River islands, White Slough, Old River islands, and Webb Tract marsh.

Wetlands

From information gathered from the U.S. Fish and Wildlife Service's National Wetland Inventory map, wetland types that would be affected on Webb and Bacon Islands are as follows:

Webb Island: Approximately 90 percent farmed wetlands, 2 percent emergent deep marsh, 5 percent open water ponds, and 3 percent drainage ditches.

Bacon Island: 95 percent farmed wetlands, 2 percent emergent deep marsh, and three drainage ditches (3 percent).

Three special-status wetland habitats — northern hardpan vernal pool, alkali meadow, and coastal and valley freshwater marsh — could be affected by the In-Delta Storage Project.

CULTURAL RESOURCES

No prehistoric sites of any kind have been found in the islands of the proposed project. It is possible that there may be one or two non-significant historic sites on these tracts.

On Bouldin and Bacon Islands, 19 sites represent the farming operations of George Shima (The Potato King). The sites include trash scatters, foundations, equipment, and boarding houses for an Asian labor camp dating to the early part of the century. Singly, these sites are not significant; but collectively, they could be eligible to be listed as a Historic District on the National Register of Historic Places.

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U.S. Geological Survey Topographic Maps, Bouldin Island and Woodward Island.

Table 1
SUMMARY OF PHYSICAL CHARACTERISTICS
IN-DELTA STORAGE PROJECT

ALTERNATIVE A - THREE ISLAND STORAGE FACILITY	
Bacon Island	
Maximum Water Surface Elevation (feet)	4.0
Maximum Water Storage Capacity (acre-feet)	107,570
Water Surface Area (acres)	5,067
Island Perimeter (miles of levee)	13.8
Siphons (to Woodward Island)	
Capacity (cfs)	5,000
Length (feet)	1,500
Number of Boxes - Dimensions	2 - 18' x 18'
Intake Pumping Station (1 - northern tip of island)	
Total Capacity (cfs)	5,000
Total Horsepower (HP)	7,570
Woodward Island	
Maximum Water Surface Elevation (feet)	4.0
Maximum Water Storage Capacity (acre-feet)	17,270
Water Surface Area (acres)	1,565
Island Perimeter (miles of levee)	8.5
Siphons (to Victoria Island)	
Capacity (cfs)	5,000
Length (feet)	700
Number of Boxes - Dimensions	2 - 18' x 18'
Victoria Island	
Maximum Water Surface Elevation (feet)	4.0
Maximum Water Storage Capacity (acre-feet)	91,370
Water Surface Area (acres)	6,767
Island Perimeter (miles of levee)	14.7
Siphons (to Clifton Court Forebay)	
Capacity (cfs)	15,000
Length (feet)	1,400
Number of Boxes - Dimensions	3 - 30' x 30'
Intake Pumping Stations (2 - east and west side of island)	
Total Capacity (cfs)	5,000
Total Horsepower (HP)	7,570
ALTERNATIVE B - SINGLE ISLAND STORAGE FACILITY	
Delta-Island Storage Facility (Bacon, Woodward, and Victoria Islands)	
Maximum Water Surface Elevation (feet)	4.0
Maximum Water Storage Capacity (acre-feet)	219,480
Water Surface Area (acres)	13,614
Delta-Island Storage Facility Perimeter (miles of levee)	31.5
Miles of Levee Removed	5.9
Miles of New Levee	0.4
Siphons (to Clifton Court Forebay)	
Capacity (cfs)	15,000
Length (feet)	1,400
Number of Boxes - Dimensions	3 - 30' x 30'
Intake Pumping Stations (3)	
Total Capacity (cfs)	5,000
Total Horsepower (HP)	7,570
Locations : northern tip of Bacon Island; west end of North Victoria Canal;	
and east end of North Victoria Canal.	

Table 2a
ESTIMATED CAPITAL COSTS
IN-DELTA STORAGE PROJECT--ALTERNATIVE A

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
I. BACON ISLAND								
Land Acquisition	5,066	AC				$3,000	$15,198,000	
Reinforce Levees								
Riprap	914,600	TON	163	181	$15.00	$16.70	$15,273,820	2, page 439
Bedding (6" thick)	258,500	TON	163	181	$14.00	$15.60	$4,032,600	2, page 439
Geotextile (bedding)	5,818,200	SF	163	181	$0.25	$0.28	$1,629,096	2, page 439
Embankment	297,100	CY	163	181	$7.00	$7.80	$2,317,380	2, page 439
Pump Station w/ fish screens (5,000 cfs ea.)	JOB	LS				$80,574,000	$80,574,000	1
Bacon-Woodward Siphon (1500')[b]								
Temporary River Alignment								
Excavation	75,615	CY	181	181	$2.50	$2.50	$189,038	5, page 7
Levees (using excavation)	75,615	CY	181	181	$3.00	$3.00	$226,845	5, page 7
Cofferdam Sheetpiling	226,200	SF	202	207	$28.00	$28.70	$6,491,940	5, page 7
Cofferdam Gravel Fill	22,200	CY	202	207	$21.00	$21.50	$477,300	5, page 7
Backfill	75,615	CY	181	181	$4.00	$4.00	$302,460	5, page 7
Dewatering	JOB	LS	202	207	$100,000	$102,500	$102,500	5, page 7
Siphon								
Excavation-Structural	255,000	CY	181	181	$6.00	$6.00	$1,530,000	5, page 7
Concrete	27,000	CY	198	213	$275	$296	$7,992,000	5, page 7
Reinforcing Steel	5,310,000	LBS	198	213	$0.60	$0.65	$3,451,500	5, page 7
Backfill	133,500	CY	181	181	$4.00	$4.00	$534,000	5, page 7
Riprap	40,500	TON	181	181	$27.00	$27.00	$1,093,500	5, page 7
Access Roads	0.26	MI	231	237	$500,000	$513,000	$133,380	5, page 7
Inlet and Outlet Transition								
Excavation	51,400	CY	181	181	$2.25	$2.25	$115,650	5, page 7
Concrete Slab	1,370	CY	198	213	$225	$242	$331,540	5, page 7
Concrete Walls	1,090	CY	198	213	$350	$377	$410,930	5, page 7
Reinforcing Steel	490,000	LBS	198	213	$0.60	$0.65	$318,500	5, page 7
Backfill	11,500	CY	181	181	$4.00	$4.00	$46,000	5, page 7
Miscellaneous @ 20%							$4,749,417	
SUBTOTAL BACON ISLAND							$147,521,395	
II. WOODWARD ISLAND								
Land Acquisition	1,565	AC				$3,000	$4,695,000	3
Reinforce Levees								
Riprap	561,600	TON	163	181	$15.00	$16.70	$9,378,720	2, page 439
Bedding (6" thick)	158,800	TON	163	181	$14.00	$15.60	$2,477,280	2, page 439
Geotextile	3,572,400	SF	163	181	$0.25	$0.28	$1,000,272	2, page 439
Embankment	182,500	CY	163	181	$7.00	$7.80	$1,423,500	2, page 439
Woodward-Victoria Siphon(700')[b]								
Temporary River Alignment								
Excavation	35,287	CY	181	181	$2.50	$2.50	$88,218	5, page 7
Levees (using excavation)	35,287	CY	181	181	$3.00	$3.00	$105,861	5, page 7

Table 2a
ESTIMATED CAPITAL COSTS
IN-DELTA STORAGE PROJECT--ALTERNATIVE A

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Cofferdam Sheetpiling	150,800	SF	202	207	$28.00	$28.70	$4,327,960	5, page 7
Cofferdam Gravel Fill	14,800	CY	202	207	$21.00	$21.50	$318,200	5, page 7
Backfill	35,287	CY	181	181	$4.00	$4.00	$141,148	5, page 7
Dewatering	JOB	LS	202	207	$100,000	$102,500	$102,500	5, page 7
Siphon								
Excavation-Structural	119,000	CY	181	181	$6.00	$6.00	$714,000	5, page 7
Concrete	12,600	CY	198	213	$275	$296	$3,729,600	5, page 7
Reinforcing Steel	2,478,000	LBS	198	213	$0.60	$0.65	$1,610,700	5, page 7
Backfill	62,300	CY	181	181	$4.00	$4.00	$249,200	5, page 7
Riprap	18,900	TON	181	181	$27.00	$27.00	$510,300	5, page 7
Access Roads	0.12	MI	231	237	$500,000	$513,000	$61,560	5, page 7
Inlet and Outlet Transition								
Excavation	51,400	CY	181	181	$2.25	$2.25	$115,650	5, page 7
Concrete Slab	1,370	CY	198	213	$225	$242	$331,540	5, page 7
Concrete Walls	1,090	CY	198	213	$350	$377	$410,930	5, page 7
Reinforcing Steel	490,000	LBS	198	213	$0.60	$0.65	$318,500	5, page 7
Backfill	11,500	CY	181	181	$4.00	$4.00	$46,000	5, page 7
Miscellaneous @ 20%							$2,636,373	
SUBTOTAL WOODWARD ISLAND							$34,793,012	
III. VICTORIA ISLAND								
Land Acquisition	6,767	AC				$3,000	$20,301,000	3
Reinforce Levees								
Riprap	973,500	TON	163	181	$15.00	$16.70	$16,257,450	2, page 439
Bedding (6" thick)	275,200	TON	163	181	$14.00	$15.60	$4,293,120	2, page 439
Geotextile	6,192,500	SF	163	181	$0.25	$0.28	$1,733,900	2, page 439
Embankment	316,200	CY	163	181	$7.00	$7.80	$2,466,360	2, page 439
Elevated Roadway (Highway 4)								
Riprap	570,200	TON	163	181	$15.00	$16.70	$9,522,340	2, page 439
Bedding (6" thick)	161,200	TON	163	181	$14.00	$15.60	$2,514,720	2, page 439
Geotextile	3,627,500	SF	163	181	$0.25	$0.28	$1,015,700	2, page 439
Embankment	819,800	CY	163	181	$7.00	$7.80	$6,394,440	2, page 439
Foundation	740,100	CY	163	181	$9.80	$10.88	$8,053,923	1
Aggregate Base	14,980	TON				$19.15	$286,867	4, item v-d
Asphalt Concrete	6,810	TON				$58.92	$401,245	4, item v-e
Causeway Bridge	21,000	SF				$100	$2,100,000	1
Victoria-CCFB Siphon (1400')[b]								
Temporary River Alignment								
Excavation	70,574	CY	181	181	$2.50	$2.50	$176,435	5, page 7
Levees (using excavation)	70,574	CY	181	181	$3.00	$3.00	$211,722	5, page 7
Cofferdam Sheetpiling	150,800	SF	202	207	$28.00	$28.70	$4,327,960	5, page 7
Cofferdam Gravel Fill	14,800	CY	202	207	$21.00	$21.50	$318,200	5, page 7
Backfill	70,574	CY	181	181	$4.00	$4.00	$282,296	5, page 7
Dewatering	JOB	LS	202	207	$100,000	$102,500	$102,500	5, page 7

Table 2a
ESTIMATED CAPITAL COSTS
IN-DELTA STORAGE PROJECT--ALTERNATIVE A

DESCRIPTION	QUANTITY	UNIT*	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Siphon								
Excavation-Structural	700,000	CY	181	181	$6.00	$6.00	$4,200,000	5, page 7
Concrete	72,800	CY	198	213	$275	$296	$21,548,800	5, page 7
Reinforcing Steel	14,546,000	LBS	198	213	$0.60	$0.65	$9,454,900	5, page 7
Backfill	364,000	CY	181	181	$4.00	$4.00	$1,456,000	5, page 7
Riprap	110,600	TON	181	181	$27.00	$27	$2,986,200	5, page 7
Access Roads	0.70	MI	231	237	$500,000	$513,000	$359,100	5, page 7
Inlet and Outlet Transition								
Excavation	101,220	CY	181	181	$2.25	$2.25	$227,745	5, page 7
Concrete Slab	2,690	CY	198	213	$225	$242	$650,980	5, page 7
Concrete Walls	2,140	CY	198	213	$350	$377	$806,780	5, page 7
Reinforcing Steel	966,000	LBS	198	213	$0.60	$0.65	$627,900	5, page 7
Backfill	22,560	CY	181	181	$4.00	$4.00	$90,240	5, page 7
Radial Gates and Hoist Assemblies	2	EA				$145,000	$290,000	
Miscellaneous @ 20%							$9,623,552	
Victoria Island Pumping Plant (Q=15,000 cfs)	JOB	LS				$59,106,000	$59,106,000	
Distributed Pump Station w/ Fish Screens (Q=5,000 cfs)	2	EA				$80,575,000	$161,150,000	
SUBTOTAL VICTORIA ISLAND							$353,338,374	
IV. SEEPAGE INTERCEPTION WELLS	JOB	LS				$5,174,000	$5,174,000	1
V. CVP-SWP IMPROVEMENTS								
Interconnection Channel CCFB to DMC with Gated Structures:								
2,800 lin. ft. of Earth Canal, Q=4,500 cfs:								
Excavation	375,000	CY				$2.00	$750,000	1
Compacted Embankment	486,000	CY				$0.80	$389,000	1
Common Embankment	203,000	CY				$0.50	$102,000	1
Borrow	557,000	CY				$5.00	$2,785,000	1
Land Cost	129	AC				$3,000	$387,000	1
Intake Structure with Radial Gates at Clifton Court Forebay	JOB	LS				$9,135,000	$9,135,000	3
Extra Set of Radial Gates Below Interconnection Channel	JOB	LS				$6,798,000	$6,798,000	1
Fish Screen at Tracy Pumping Plant	4,500	CFS				$10,000	$45,000,000	1
SUBTOTAL CVP - SWP IMPROVEMENTS							$65,346,000	
SUBTOTAL COST ITEMS FOR IN-DELTA STORAGE PROJECT--ALTERNATIVE A							606,200,000	
CONTINGENCIES @ 20%							$121,200,000	
ESTIMATED CONSTRUCTION COST							$727,400,000	
ENGR., LEGAL, AND ADMIN. @ 35%							$254,600,000	
ESTIMATED CAPITAL COST							$982,000,000	
ESTIMATED CAPITAL COST RANGE								
LOW (-10 %)							$884,000,000	
HIGH (+25%)							$1,228,000,000	

Table 2a
ESTIMATED CAPITAL COSTS
IN-DELTA STORAGE PROJECT--ALTERNATIVE A

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE

Footnotes:

[a]SF=square foot; LS=lump sum; CY=cubic yard; AC=acre; CFS=cubic feet per second; HP=horsepower; LBS=pound; MI=mile; EA=each.

[b] The USBR index date for all siphons is September 95, not the October 1990 date shown above.

Cost References:

1. Cost developed by Bookman-Edmonston Engineering.
2. California Department of Water Resources, *North Delta Program Draft EIR, EIS*, November 1990.
3. U.S. Bureau of Reclamation, Land Resources Branch, Graham McMullen, February 1997.
4. California Department of Water Resources, *Los Banos Grandes Facilities Report, Appendix A: Designs and Cost Estimates, December 1990.*
5. California Department of Water Resources, *Isolated Transfer Facility Cost Estimate,* September 1995.

Table 2b
ESTIMATED CAPITAL COSTS
IN-DELTA STORAGE PROJECT--ALTERNATIVE B

DESCRIPTION	QUANTITY	UNIT*	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
I. BACON ISLAND								
Land Acquisition	5,138	AC				$3,000	$15,414,000	3
Reinforce Levees								
Riprap	847,400	TON	163	181	$15.00	$16.70	$14,151,580	2, page 439
Bedding (6" thick)	239,500	TON	163	181	$14.00	$15.60	$3,736,200	2, page 439
Geotextile (bedding)	5,391,000	SF	163	181	$0.25	$0.28	$1,509,480	2, page 439
Embankment	275,300	CY	163	181	$7.00	$7.80	$2,147,340	2, page 439
Remove Levee (South Boundary)								
Embankment	256,800	CY	163	181	$4.00	$4.50	$1,155,600	2, page 439
Riprap	9,100	TON	163	181	$7.50	$8.40	$76,440	2, page 439
New Levee (Between Bacon Island and Woodward Island)								
Embankment	113,800	CY	163	181	$7.00	$7.80	$887,640	2, page 439
Foundation	62,500	CY	163	181	$9.80	$10.90	$681,250	2, page 439
Bedding (6" thick)	5,000	TON	163	181	$14.00	$15.60	$78,000	2, page 439
Geotextile (bedding)	111,900	SF	163	181	$0.25	$0.28	$31,332	2, page 439
Riprap	17,600	TON	163	181	$15.00	$16.70	$293,920	2, page 439
Pump Station w/ fish screens (Q=5,000 cfs)	JOB	LS				$80,575,000	$80,575,000	1
SUBTOTAL BACON ISLAND							$120,737,782	
II. WOODWARD ISLAND								
Land Acquisition	1,637	AC				$3,000	$4,911,000	3
Reinforce Levees								
Riprap	365,000	TON	163	181	$15.00	$16.70	$6,095,500	2, page 439
Bedding (6" thick)	103,200	TON	163	181	$14.00	$15.60	$1,609,920	2, page 439
Geotextile	2,322,000	SF	163	181	$0.25	$0.28	$650,160	2, page 439
Embankment	118,600	CY	163	181	$7.00	$7.80	$925,080	2, page 439
Remove Levee (North and South Boundaries)								
Embankment	751,200	CY	163	181	$4.00	$4.50	$3,380,400	2, page 439
Riprap	26,600	TON	163	181	$7.50	$8.40	$223,440	2, page 439
New Levee (Between Woodward Isl. and Victoria Isl.)								
Embankment	65,000	CY	163	181	$7.00	$7.80	$507,000	2, page 439
Foundation	35,700	CY	163	181	$9.80	$10.90	$389,130	2, page 439
Bedding (6" thick)	2,900	TON	163	181	$14.00	$15.60	$45,240	2, page 439
Geotextile	63,900	SF	163	181	$0.25	$0.28	$17,892	2, page 439
Riprap	10,100	TON	163	181	$15.00	$16.70	$168,670	2, page 439
Pump Station w/ fish screens (Q=5,000 cfs)	2	EA				$80,575,000	$80,575,000	1
Railroad Trestle	128,400	SF				$100	$12,840,000	1
Raise Mokelumne Aqueduct	JOB	LS				$19,700,000	$19,700,000	1
SUBTOTAL WOODWARD ISLAND							$132,038,432	
III. VICTORIA ISLAND								
Land Acquisition	6,839	AC				$3,000	$20,517,000	
Reinforce Levees								
Riprap	844,100	TON	163	181	$15.00	$16.70	$14,096,470	2, page 439

Table 2b
ESTIMATED CAPITAL COSTS
IN-DELTA STORAGE PROJECT--ALTERNATIVE B

DESCRIPTION	QUANTITY	UNIT	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Bedding (6" thick)	238,600	TON	163	181	$14.00	$15.60	$3,722,160	2, page 439
Geotextile	5,369,500	SF	163	181	$0.25	$0.28	$1,503,460	2, page 439
Embankment	274,200	CY	163	181	$7.00	$7.80	$2,138,760	2, page 439
Remove Levee (North Boundary)								
Embankment	494,400	CY	163	181	$4.00	$4.50	$2,224,800	2, page 439
Riprap	17,500	TON	163	181	$7.50	$8.40	$147,000	2, page 439
Victoria - CCFB Siphon (1400)								
Temporary River Alignment								
Excavation	70,574	CY	181	181	$2.50	$2.50	$176,435	5, page 7
Levees	70,574	CY	181	181	$3.00	$3.00	$211,722	5, page 7
Cofferdam Sheetpiling	150,800	SF	202	207	$28.00	$28.70	$4,327,960	5, page 7
Cofferdam Gravel Fill	14,800	CY	202	207	$21.00	$21.50	$318,200	5, page 7
Backfill	70,574	CY	181	181	$4.00	$4.00	$282,296	5, page 7
Dewatering	JOB	LS	202	207	$100,000	$102,500	$102,500	5, page 7
Siphon								
Excavation	410,200	CY	181	181	$6.00	$6.00	$2,461,200	5, page 7
Concrete	42,000	CY	198	213	$275	$296	$12,432,000	5, page 7
Reinforcing Steel	8,514,800	LBS	198	213	$0.60	$0.65	$5,534,620	5, page 7
Backfill	212,800	CY	181	181	$4.00	$4.00	$851,200	5, page 7
Riprap	64,400	TON	181	181	$27.00	$27.00	$1,738,800	5, page 7
Access Roads	0.41	MI	231	237	$500,000	$513,000	$210,330	5, page 7
Inlet and Outlet Transition								
Excavation	67,480	CY	181	181	$2.25	$2.25	$151,830	5, page 7
Concrete Slab	1,800	CY	198	213	$225	$242	$435,600	5, page 7
Concrete Walls	1,430	CY	198	213	$350	$377	$539,110	5, page 7
Reinforcing Steel	644,000	LBS	198	213	$0.60	$0.65	$418,600	5, page 7
Backfill	15,040	CY	181	181	$4.00	$4.00	$60,160	5, page 7
Radial Gates and Hoist Assemblies	2	EA				$255,000	$510,000	5, page 7
Miscellaneous @ 20%							$6,152,513	
Elevated Roadway (Highway 4)								
Riprap	570,200	TON	163	181	$15.00	$16.70	$9,522,340	2, page 439
Bedding (6" thick)	161,200	TON	163	181	$14.00	$15.60	$2,514,720	2, page 439
Geotextile	3,627,500	SF	163	181	$0.28	$0.28	$1,015,700	2, page 439
Embankment	819,800	CY	163	181	$7.00	$7.80	$6,394,440	2, page 439
Foundation	740,100	CY	163	181	$9.80	$10.90	$8,067,090	1
Aggregate Base	14,980	TON				$19.15	$286,867	4, item v-d
Asphalt Concrete	6,810	TON				$58.92	$401,245	4, item v-d
Causeway Bridge	21,000	SF				$100	$2,100,000	1
Victoria Island Pumping Plant (Q=15,000 cfs)	JOB	LS				$59,106,000	$59,106,000	1
SUBTOTAL VICTORIA ISLAND							$170,673,128	
IV. SEEPAGE INTERCEPTION WELLS	JOB	LS				$5,174,000	$5,174,000	1

Table 2b
ESTIMATED CAPITAL COSTS
IN-DELTA STORAGE PROJECT--ALTERNATIVE B

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
V. CVP-SWP IMPROVEMENTS								
Interconnection Channel CCFB to DMC with Gated Structures:								
2,800 lin. ft. of Earth Canal, Q=4,500 cfs:								
Excavation	375,000	CY				$2.00	$750,000	1
Compacted Embankment	486,000	CY				$0.80	$389,000	1
Common Embankment	203,000	CY				$0.50	$102,000	1
Borrow	557,000	CY				$5.00	$2,785,000	1
Land Cost	129	AC				$3,000	$387,000	1
Intake Structure with Radial Gates at Clifton Court Forebay	JOB	LS				$9,135,000	$9,135,000	3
Extra Set of Radial Gates Below Interconnection Channel	JOB	LS				$6,798,000	$6,798,000	1
Fish Screen at Tracy Pumping Plant	4,500	CFS				$10,000	$45,000,000	1
SUBTOTAL CVP - SWP IMPROVEMENTS							$65,346,000	
SUBTOTAL COST ITEMS FOR IN-DELTA STORAGE--ALTERNATIVE B							$494,000,000	
CONTIGENCIES @ 20%							$98,800,000	
ESTIMATED CONSTRUCTION COST							$592,800,000	
ENGINEERING, LEGAL, AND ADMINISTRATIVE FEES @ 35%							$207,500,000	
ESTIMATED CAPITAL COST							$800,300,000	
ESTIMATED CAPITAL COST RANGE								
LOW (-10%)							$720,000,000	
HIGH (+25%)							$1,000,000,000	

Footnotes:

[a] SF=square foot; LS=lump sum; CY=cubic yard; AC=acre; CFS=cubic feet per second; HP=horsepower; LBS=pound; MI=mile; EA=each.

[b] The USBR index date for all siphons is September 95, not the October 1990 date shown above.

Cost References:

1. Cost developed by Bookman-Edmonston Engineering.
2. California Department of Water Resources, *North Delta Program Draft EIR, EIS*, November 1990.
3. U.S. Bureau of Reclamation, Land Resources Branch, Graham McMullen, February 1997.
4. California Department of Water Resources, *Los Banos Grandes Facilities Report, Appendix A: Designs and Cost Estimates, December 1990.*
5. California Department of Water Resources, *Isolated Transfer Facility Cost Estimate,* September 1995.

Table 3
SUMMARY OF ESTIMATED CAPITAL COSTS
IN-DELTA STORAGE PROJECT

Cost Item	Estimated Costs ($Million)
ALTERNATIVE A - THREE ISLAND STORAGE FACILITY	
Bacon Island	
Land Acquisition	$15.2
Levee Reinforcement	$23.3
Intake Pumping Station w/ Fish Screens	$80.6
Siphons to Woodward Island	$28.4
SUBTOTAL	$147.5
Woodward Island	
Land Acquisition	$4.7
Levee Reinforcement	$14.3
Siphons to Victoria Island	$15.8
SUBTOTAL	$34.8
Victoria Island	
Land Acquisition	$20.3
Levee Reinforcement	$24.7
Intake Pumping Station w/ Fish Screens	$161.2
Elevated Highway 4	$30.3
Siphons w/ 15,000 cfs Pumping Plant to Clifton Court Forebay	$116.8
SUBTOTAL	$353.3
Seepage Interception Wells	$5.2
SWP-CVP Improvements	$65.4
SUBTOTAL COST ITEMS	$606.2
Contingencies @ 20%	$121.2
ESTIMATED CONSTRUCTION COST	$727.4
Engineering, Legal, and Admin. @ 35%	$254.6
ESTIMATED PROJECT CAPITAL COST (minus 10% - plus 25%)	$982.0
ESTIMATED CAPITAL COST RANGE	$884 - $1,228
ALTERNATIVE A - SINGLE ISLAND STORAGE FACILITY	
Bacon Island	
Land Acquisition	$15.4
Levee Reinforcement	$21.5
Levee Removal	$1.2
New Levee Construction	$2.0
Intake Pumping Station w/ Fish Screens	$80.6
SUBTOTAL	$120.7
Woodward Island	
Land Acquisition	$4.9
Levee Reinforcement	$9.3
Levee Removal	$3.6
New Levee Construction	$1.1
Intake Pumping Station w/ Fish Screens	$80.6
Railroad and Mokelumne Aqueduct Trestle	$32.5
SUBTOTAL	$132.0

Table 3
SUMMARY OF ESTIMATED CAPITAL COSTS
IN-DELTA STORAGE PROJECT

Cost Item	Estimated Costs ($Million)
Victoria Island	
Land Acquisition	$20.5
Levee Reinforcement	$21.5
Levee Removal	$2.4
Elevated Highway 4	$30.3
Siphons w/ 15,000 cfs Pumping Plant to Clifton Court Forebay	$96.0
SUBTOTAL	$170.7
Seepage Interception Wells	$5.2
SWP-CVP Improvements	$65.4
SUBTOTAL COST ITEMS	$494.0
Contingencies @ 20%	$98.8
ESTIMATED CONSTRUCTION COST	$592.8
Engineering, Legal, and Admin. @ 35%	$207.5
ESTIMATED PROJECT CAPITAL COST (minus 10% - plus 25%)	$800.3
ESTIMATED CAPITAL COST RANGE	$720 - $1,000

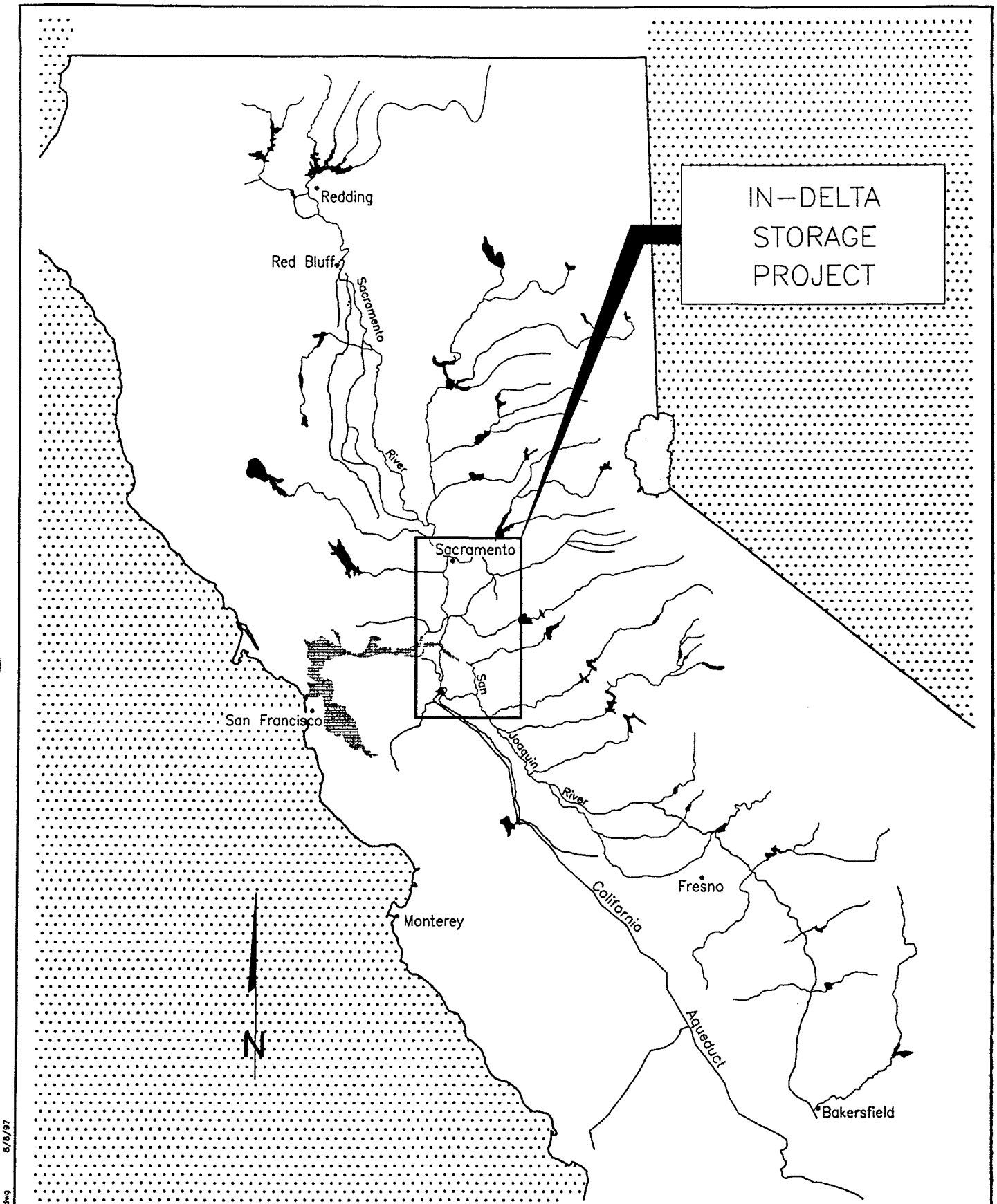

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Figure 1

Project Location Map

In–Delta Storage Project

CALFED BAY–DELTA PROGRAM

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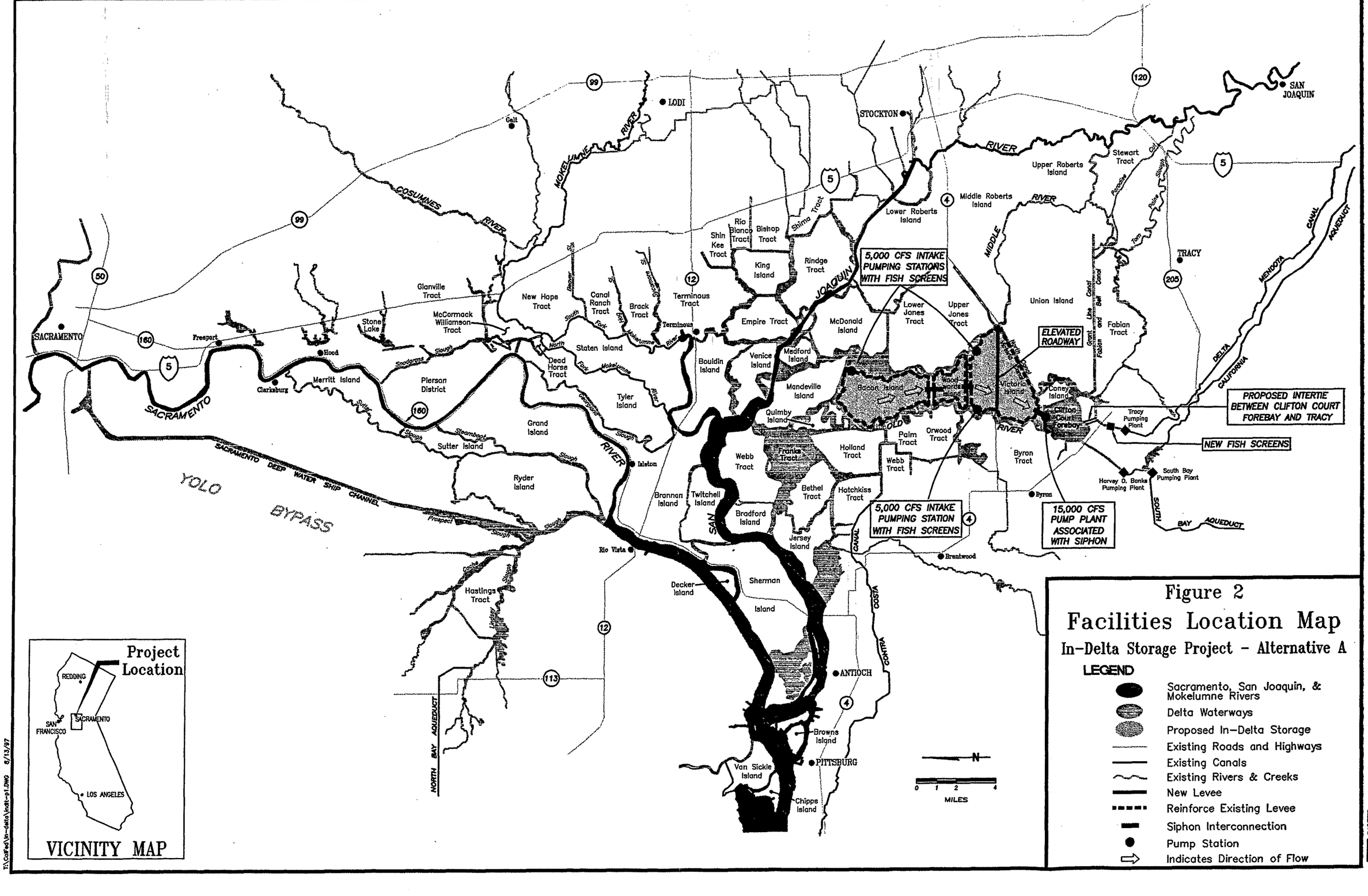

Project Location

VICINITY MAP

Figure 2
Facilities Location Map
In-Delta Storage Project - Alternative A

LEGEND

- Sacramento, San Joaquin, & Mokelumne Rivers
- Delta Waterways
- Proposed In-Delta Storage
- Existing Roads and Highways
- Existing Canals
- Existing Rivers & Creeks
- New Levee
- Reinforce Existing Levee
- Siphon Interconnection
- Pump Station
- Indicates Direction of Flow

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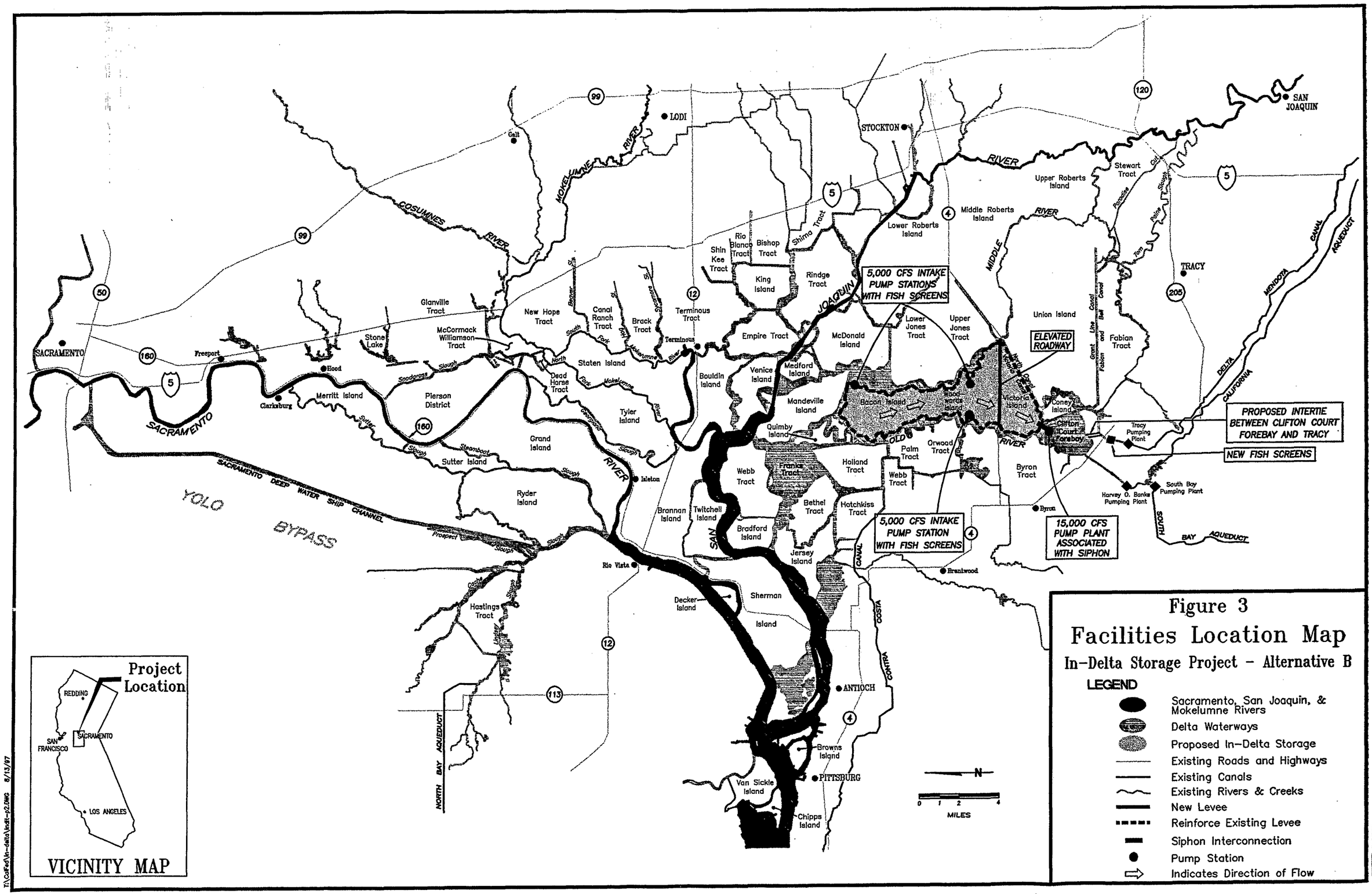

Figure 3

Facilities Location Map

In-Delta Storage Project - Alternative B

LEGEND

- Sacramento, San Joaquin, & Mokelumne Rivers
- Delta Waterways
- Proposed In-Delta Storage
- Existing Roads and Highways
- Existing Canals
- Existing Rivers & Creeks
- New Levee
- Reinforce Existing Levee
- Siphon Interconnection
- Pump Station
- Indicates Direction of Flow

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FACILITY DESCRIPTIONS AND UPDATED COST ESTIMATES FOR AN ISOLATED DELTA CONVEYANCE FACILITY

Prepared by the CALFED Storage and Conveyance Refinement Team
October 1997

D-008824

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INTRODUCTION

The *Facility Descriptions and Updated Cost Estimates for an Isolated Delta Conveyance Facility* has been prepared as part of the Storage and Conveyance Component Refinement Task of the CALFED Bay-Delta Program (CALFED or Program). CALFED's mission is to develop a long-term comprehensive plan that will restore the ecological health and improve water management for beneficial uses of the San Francisco Bay/Sacramento-San Joaquin Delta (Bay-Delta) system.

This report summarizes the principal features, estimated costs, and environmental considerations of constructing a hydraulically isolated conveyance facility through the Sacramento-San Joaquin Delta (Delta) from the Sacramento River to Clifton Court Forebay. The general location of the Isolated Delta Conveyance Facility (Isolated Facility) is shown on Figure 1. This evaluation and others being performed by CALFED are intended to provide facility descriptions and updated cost estimates of representative storage and conveyance components. The objectives of the Isolated Facility evaluation are to (1) provide an updated estimate of the capital cost of constructing this facility within the range expected if the project were to be constructed today and (2) enable CALFED to compare this project against other projects that might be considered as part of a long-term CALFED solution strategy.

The cost estimate for the Isolated Facility was primarily determined by escalating the costs found in three reports: the 1996 CALFED Bay-Delta Program Report titled *Preliminary Evaluation of 5,000 cfs Isolated Transfer Facility Using Buried Pipeline*, the September 1995 California Department of Water Resources (DWR) report titled *Cost Estimate — Isolated Transfer Facility*, and the October 1964 U.S. Bureau of Reclamation (Reclamation) report titled *Reconnaissance Estimate, Delta Division — Peripheral Canal.* The cost estimates performed by CALFED, DWR, and Reclamation were reviewed and adapted for this evaluation. Modification to the

previous cost estimates have been made where appropriate to reflect current design and safety standards.

A preliminary evaluation of the environmental considerations associated with the Isolated Facility has been included in this report. Fish, wildlife, plant, and cultural resources that could be affected have been described and potential impacts have been identified. The information for the evaluation of environmental considerations was gathered from existing literature and databases.

PROJECT BACKGROUND

Development of the Delta began in the 19th century. Reclamation of Delta marshlands began in the 1850s; by the 1930s, nearly all of the Delta had been reclaimed into intensively farmed islands. Ocean salinity intrusion to the interior of the Delta was observed as early as the 1840s and was recognized as a potential problem to water supplies. Since that time, there have been numerous studies of methods to control salinity intrusion and otherwise improve the management of the water resources of the Delta.

In 1960, California voters approved the Burns-Porter Act to assist in the financing of the State Water Project (SWP). This Act authorized Delta facilities "... for water conservation, water supply in the Delta, transfer of water across the Delta, flood and salinity control, and related functions." In the same year, DWR proposed the Delta Water Project to serve as the Delta water facility of the SWP. This plan, however, was met with stiff opposition from Delta water users, boaters, fish and wildlife agencies, and other Delta interests. Consequently, DWR and the California Department of Fish and Game (CDFG) established the Delta Fish and Wildlife Protection Study and the Interagency Delta Commission (with Reclamation and the U.S. Army Corps of Engineers) to develop a mutually acceptable plan for the Delta. In 1965, the Interagency Delta Commission recommended the Peripheral Canal as the water transfer plan.

The Peripheral Canal would convey water from the Sacramento River at Hood to the State and federal pumping plants in the south Delta. The Peripheral Canal would eliminate interference with Delta waterways and would release freshwater to Delta channels to maintain water quality and mitigate impacts to fish.

In 1966, DWR designated the Peripheral Canal as the Delta Facility of the SWP. In 1969, the Department of the Interior (Interior) adopted Reclamation's Peripheral Canal Feasibility Report, which recommended that the project be a joint-use facility of the SWP and the Central Valley Project (CVP) with costs shared equally. Although the Peripheral Canal was supported by two subsequent administrations, the facility was never constructed, partly for the following reasons:

- Although the Interior and Reclamation supported the facility, federal funding was never forthcoming.
- There was continuing fear of and controversy over the cost of the canal and of potential harm from improper operation. Some water users believed that water could be obtained at a lower cost. Also, some Delta interests feared that in times of water shortage, institutional, statutory, and contractual guarantees for Delta protection could be changed or ignored and water needed to protect the Delta would be exported.

In 1975, DWR began to reassess the Peripheral Canal resulting in Bulletin 76 (July 1978), which identified and considered numerous alternative water transfer facilities. In 1980, the State Legislature passed, and the Governor signed, Senate Bill (SB) 200. This bill authorized the Peripheral Canal and provided specific guarantees to protect the Delta and to meet the water needs of the SWP through the year 2000. SB 200 was subjected to a statewide referendum vote in June 1982, which California voters did not approve.

The rejection of SB 200 by the voters did not alleviate the need to increase the amount of water transferred across the Delta and at the same time meet the water needs of the Delta itself. Since

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that time, alternative water transfer plans for the Delta have been investigated by DWR and other agencies. In 1983, DWR published *Alternatives for Delta Water Transfer*, which examined four alternatives for improving the water transfer system. The alternatives examined in the DWR report included a dual transfer facility that included an isolated conveyance facility (similar to the Peripheral Canal) and improvements to channel conveyance capacities in the north and south Delta. This dual conveyance configuration did not pass the selection process used in that investigation.

In the process of developing a long-term comprehensive plan to restore the ecological health of and improve water management in the Bay-Delta, CALFED has selected to evaluate an Isolated Conveyance Facility similar in configuration to the Peripheral Canal. This evaluation will provide an updated estimate of the capital cost of constructing an isolated conveyance facility and will enable CALFED to compare this facility to other projects that might be considered for improving the conveyance of water through the Delta. Additionally, CALFED will consider a dual conveyance configuration that provides for an isolated conveyance facility in combination with improvements to Delta channel capacities. Improvements to through Delta conveyance capacities has been described in a similar CALFED evaluation titled *Facilities Descriptions and Updated Cost Estimates for an Improved Through Delta Conveyance Facility.*

FACILITIES DESCRIPTION

This section provides an overview of the major features included in the Isolated Facility. This evaluation includes three alternative conveyance capacities: 5,000, 10,000, and 15,000 cubic feet per second (cfs). The alternative conveyance capacities described in this evaluation are intended to be combined with other Delta improvements to form various dual Delta conveyance configurations. Dual Delta conveyance configurations would transfer a portion of the south Delta export demand through an Isolated Facility and a portion through Delta channels.

PROJECT LOCATION

The general project location of the Isolated Facility is shown in Figure 1. The Isolated Facility would be located in the Delta in Sacramento and San Joaquin Counties. The proposed alignment of the Isolated Facility would begin at the Sacramento River near the community of Hood and progress in a southeasterly direction toward the City of Stockton crossing the San Joaquin River at a point approximately 5 miles west of Stockton. It would then continue in a southwesterly direction to Clifton Court Forebay. The alignment is approximately 44 miles in length. Figure 2 provides a detailed facilities location map of the Isolated Facility. The alignment and locations of all facilities are the same for the three alternative conveyance capacities examined in this evaluation.

PROJECT DESCRIPTION

The Isolated Facility concept consists of an unlined canal, hydraulically isolated from existing Delta channels, to convey Sacramento River water around the eastern edge of the Delta to the federal and State pumping plants in the south Delta. As proposed, the Isolated Facility would help alleviate fish and water quality concerns in the Bay-Delta. Also, degradation of the quality of export water from seawater intrusion and return flows from irrigation in the Delta and San Joaquin Valley would be eliminated. As mentioned earlier, the Isolated Facility would be combined with other Delta improvements to form a dual Delta conveyance system.

PRINCIPAL FACILITIES

This section provides an overview of the major features of the 5,000, 10,000, and 15,000 cfs Isolated Facility alternatives. The principal facilities for each alternative include an intake channel with associated works; a pumping plant; 44 miles of unlined canal; 11 inverted siphons for river and slough crossings; and 17 bridges for county road, state highway, and railroad

crossings. Table 1 provides a summary of the physical characteristics of the major facilities associated with the three alternative conveyance capacities of the Isolated Facility.

Intake Facilities

The intake channel of the Isolated Facility would include some corrective works in the Sacramento River channel, along with a trash deflector, trashrack, and floodgates. From the intake structure, an open channel would lead south and include a sedimentation basin, vertical flatplate "V" fish screens with baffles, a fish bypass system with an adjustable inclined weir, control buildings, and a bridge for Highway 160. Water entering the channel would flow through a trash deflector and trashrack, then through radial floodgates into a sedimentation basin. At the downstream end of the sedimentation basin, water would flow through a fish screen facility.

Pumping Plant

A major feature of the Isolated Facility would be a large low-lift pumping plant located immediately downstream of the sedimentation basin and fish screens. The plant would provide the hydraulic head necessary for operating the canal and for controlling the hydraulics of the fish screening facility. The pumping plant structure would be an indoor type, housing 11 pumping units, including one standby unit, for each of the three alternative conveyance capacities in this evaluation. The total horsepower for the 5,000, 10,000, and 15,000 cfs pumping plants would be 8,360, 16,720, and 25,080 horsepower, respectively. During periods when sufficient head would be available to operate the canal without pumping, 5,000 cfs could be diverted around the pumping plant through a bypass structure and flow by gravity to the Tracy and Delta Pumping Plants.

Unlined Canal

The Isolated Facility would have an unlined canal with mild side slopes near the normal water surface elevation of canal. The 44-mile canal would begin at the Sacramento River near the community of Hood and would progress in a southeasterly direction toward the city of Stockton. After crossing the San Joaquin River at a point 5 miles west of Stockton, the canal would continue in a southwesterly direction until terminating in Clifton Forebay. As shown in Figure 3, the typical cross-sections of the 5,000, 10,000, and 15,000 cfs canals would be similar. The canal would have a trapezoidal cross-section with 8:1 side slopes for the top quarter of the canal depth and 3:1 side slopes for the bottom three-quarter of the canal depth. Backslopes would be 2:1 and special treatment would be required in areas where the peat soil may pose a threat to stability. Located on either side of the canal would be a 20-foot-wide operations and maintenance (O&M) road. A 1,000-foot canal right-of-way width for the entire 44-mile alignment would be required for each of the alternative conveyance capacities.

The 5,000 cfs canal alternative would have a top width of 337 feet, a bottom width of 60 feet, and a depth of 27 feet from the normal operating water surface elevation. The 10,000 cfs canal alternative would have a top width of 442 feet, a bottom width of 100 feet, and a depth of 35 feet from the normal operating water surface elevation. The 15,000 cfs canal alternative would have a top width of 513 feet, a bottom width of 140 feet, and a depth of 36 feet from the normal operating water surface elevation.

Siphons

The Isolated Facility would include inverted siphons at four major river crossings: the Mokelumne, San Joaquin, Old, and Middle Rivers. In addition, the Isolated Facility would include seven additional inverted siphons to cross 14-Mile, White, Sycamore, Hog, Beaver, Lost, and Snodgrass Sloughs. Table 1 provides a summary of the physical features and sizes of each

siphon with specific data for the 5,000, 10,000, and 15,000 cfs alternatives. Generally, the siphon crossing would include three 26' x 26' concrete boxes for the 5,000 cfs alternative, four 30' x 30' concrete boxes for the 10,000 cfs alternative, and six 30' x 30' concrete boxes for the 15,000 cfs alternative.

Bridges and Utility Relocations

Bridges would be constructed at all main county road, state highway, and railroad crossings. These would include State Highway 24, State Highway 12, State Highway 4, Tracy Road, Lambert Road, Laurel Lane, Walnut Grove Road, Peltier Road, Woodbridge Road, Atherton Road, McDonal Road, Calpack Road, Bonatti Road, Middle River Operations and Maintenance Road, Southern Pacific Railroad, Western Pacific Railroad, and Amtrack and San Francisco Railroad main line. Each bridge would have a 12-foot clearance above the highest canal operating level and would have a removable midspan section to permit dredger passage during excavation and maintenance operations.

COST ESTIMATE

The cost estimate for the Isolated Facility is based on the 1996 CALFED Bay Delta Program Report titled *Preliminary Evaluation of 5,000 cfs Isolated Transfer Facility Using Buried Pipeline*, the 1995 DWR Report titled *Isolated Delta Conveyance*, and the 1964 Reclamation Report titled *Reconnaissance Estimate, Delta Division — Peripheral Canal.* Additional project costs identified in these reports, including environmental documentation and mitigation, operation and maintenance, power, and interest during construction, are not included in this estimate.

COST ESTIMATE METHODOLOGY

The cost estimates in previous studies developed by CALFED, DWR, and Reclamation have been reviewed and adapted for the present cost estimate. Several items in the previous cost estimates have been modified to ensure that current design standards and safety factors were incorporated.

The estimated capital cost of the Isolated Facility was determined by applying current unit costs to quantities provided in previous reports and to quantities developed by Bookman-Edmonston Engineering. Some of the costs used to update this cost estimate were determined by escalating these unit costs to October 1996 dollars using the Reclamation's Construction Cost Trends (CCT) indices. Additional unit costs were developed by Bookman-Edmonston Engineering based on engineering and construction experience.

Tables 2a, 2b, and 2c provide a detailed breakdown of the estimated costs of an Isolated Facility with capacities of 5,000, 10,000, and 15,000 cfs, respectively. An updated cost estimate for cost items identified in the previous cost estimates has been provided, along with the quantities of the cost item or an indication that the estimated cost has been developed through a lump sum approach. These tables also include the CCT indices for the month and year in which the estimated cost was developed and for October 1996. In some instances, only a unit cost has been provided, with no cost indices. In these cases, the unit cost has been taken from other sources. In addition, the far right hand column of each table provides the cost reference for each cost item.

Pumping Plants

The cost estimate for the Isolated Facility was based on the actual construction costs for the Waddell Pumping-Generating Plant in Arizona, which was completed in 1994 and is similar in size and scope to the Isolated Facility Pumping Plant. To develop a cost for the Isolated Facility

Pumping Plant, the actual construction cost of the Waddell Pumping-Generating Plant (escalated to October 1996 dollars) was factored by the following empirical equation:

$$\frac{(Cost)_1}{(Cost)_2} = \frac{HP_1^{6/10}}{HP_2^{6/10}}$$

where HP is equal to horsepower.

This cost factor formula is typically valid over moderate ranges in horsepower; the validity over larger ranges is undetermined. The impact of any error resulting from utilizing this ratio beyond its valid range is considered to be within the accuracy of the present cost estimate.

Right-of-Way Costs

Right-of-way costs of $5,000 per acre were based on land use costs developed by Reclamation, Land Resources Branch (Personal Communication, March 1997). Reclamation provided land use cost estimates at a subappraisal level for all storage and conveyance components reviewed by CALFED. The right-of-way width for each of the three capacities would be 1,000 feet for the 44-mile length resulting in a total acreage of 5,330 acres. The resulting right-of-way cost would be approximately $26.7 million. The right-of-way cost is the same in all three alternatives.

Contingencies and Other Costs

All contingencies and engineering, construction management, and administrative factors were determined by engineering judgment based on similar levels of cost estimation. Contingencies were chosen to be 20 percent; engineering, construction management, and administration were chosen to be 35 percent. A cost range was developed for the project by subtracting 10 percent

from the estimated capital cost for the low-end cost and adding 15 percent to the estimated capital cost for the high-end cost.

PRELIMINARY COST FINDINGS

Costs of the Isolated Facility and its supporting facilities have been updated to an October 1996 basis as described above. Table 3 summarizes estimated costs for the 5,000, 10,000, and 15,000 cfs alternatives.

The total estimated capital cost of the 5,000 cfs Isolated Facility alternative is $846 million with a resulting calculated range of costs between $762 and $973 million.

The total estimated capital cost of the 10,000 cfs Isolated Facility alternative is $1,079 million with a resulting calculated range of costs between $971 and $1,241 million.

The total estimated capital cost of the 15,000 cfs Isolated Facility alternative is $1,279 million with a resulting calculated range of costs between $1,151 and $1,471 million.

ENVIRONMENTAL CONSIDERATIONS

[NOTE: The Environmental Considerations section needs to be reevaluated by DWR to ensure consistency with the information presented in the previous sections.]

This portion of the report provides a summary of environmental considerations related to the proposal for developing an Isolated Facility from Hood to Clifton Court Forebay. Fish, wildlife, plant, and cultural resources that could be affected by the proposal are described and the extent of the impacts is identified. The information presented in this section was gathered from existing literature, with limited original research. No field work was conducted for this analysis.

WILDLIFE

Approximately 5,300 acres of right-of-way would be needed to construct the Isolated Facility. Most of the land within the right-of-way is used for agriculture.

Fish, Amphibians, Reptiles, and Invertebrates

Several species of fish are dependant on the Delta as a migration corridor, nursery, or permanent residence. These species include striped bass, chinook salmon, steelhead trout, American shad, sturgeon, catfish, delta smelt, and largemouth bass.

The conveyance facility would cross several waterways that support both anadromous and resident (game and non-game) fish. Construction of the facility could affect fish habitats at the intake section of the canal. Habitats at the river and slough crossings would also be impacted during construction.

The Isolated Facility has the potential to alter the present environment of the Delta estuary in a positive way. Presently, without an Isolated Facility, downstream migrants in the Sacramento and San Joaquin Rivers face potential losses at the southern Delta export points. With an Isolated Facility, fish would be subject to potential losses only at the Hood intake. The degree of impacts to fisheries depends on the amount, rate, and timing of diversions and the efficiency of the fish screens. The San Joaquin downstream migrants would not be subjected to any of the major export diversions. With an Isolated Facility, it may be possible that Delta fish downstream of the intake would no longer be subjected to export diversions, especially resident fish such as delta smelt.

It is likely that juvenile and adult striped bass will benefit from an Isolated Facility, and with certain mitigation measures, survival for this species could be equal to or better than historic

levels. With an isolated conveyance facility, chinook salmon migrating to and from the San Joaquin River should be able to migrate through the Delta without interference caused by CVP and SWP operations. Run sizes would continue to depend mainly on upstream conditions in the spring.

Overall, the Isolated Facility has the potential to correct existing undesirable effects on Sacramento River chinook salmon. The extent of the benefit will depend largely on the operation of the facility and the efficiency of fish screens. Chinook salmon migrating to and from the Sacramento River constitute the greatest percentage of migrating salmon in the Central Valley. With an Isolated Facility, a large percentage of the downstream migrants would be screened at the intake. The diminished flows below the intake could extend existing conditions in the lower estuary further upstream. This could delay Sacramento River outmigrants somewhat and reduce survival, most likely as a result of increased predation. However, if temperature and food conditions are suitable, no adverse effect would be expected. Such flow reductions would probably have little effect on upstream migrants if temperature and dissolved oxygen conditions are satisfactory.

General Wildlife

Lands within the alignment of the proposed Isolated Facility support a highly diverse faunal assemblage. Important groups of wildlife dependant on the Delta environment are waterfowl and other migratory birds, game birds such as pheasant and quail, furbearers, and numerous nongame birds and mammals. The Delta is particularly important to waterfowl migrating via the Pacific Flyway. The principal attraction for waterfowl is winter flooded agricultural fields, which provide food and extensive seasonal wetlands. Small mammals find suitable habitat in the Delta and upland areas. Vegetated levees, remanent riparian forest, and undeveloped islands provide habitat for numerous small mammals. Small mammal species include muskrat, mink, river otter,

beaver, raccoon, gray fox, and skunks. A variety of non-game wildlife such as songbirds, hawks, owl, reptiles, and amphibians can also live in the area.

Sensitive and Listed Fish and Wildlife Species

The wildlife species recorded (CNDDB) in or around the area that would be directly affected by the proposed Isolated Facility include California red-legged frog (federal threatened), Swainson's hawk (State threatened), California black rail (State threatened), western yellow billed cuckoo (State endangered), bank swallow (State threatened), San Joaquin kit fox (federal endangered, State threatened), giant garter snake (federal and State threatened), vernal pool fairy shrimp (federal threatened), vernal pool tadpole shrimp (federal endangered), and the valley elderberry longhorn beetle (federal threatened). Other listed species that have not been previously recorded in the area affected by the canal but could potentially occur there and species that could be indirectly affected by the proposal include American peregrine falcon (federal endangered), Aleutian Canada goose (federal threatened), bald eagle (federal threatened, State endangered), winter-run chinook salmon (federal endangered), delta smelt (federal threatened), and Delta green ground beetle (federal threatened).

Wildlife species that are either candidates for State or federal listing, considered species of special concern by the CDFG that have been known to occur in or near the area affected by the proposed Isolated Facility include California tiger salamander (federal candidate/CDFG species of special concern), foothill yellow-legged frog (federal species of concern, CDFG species of concern), double crested cormorant (CDFG species of special concern), great blue heron, great egret, white-tailed kite, burrowing owl (CDFG/Audubon species of special concern), tricolored blackbird (federal candidate, CDFG species of special concern), Sacramento splittail (federal proposed endangered, CDFG species of special concern), San Joaquin pocket mouse (CDFG species of special concern), and northwestern pond turtle (federal candidate/CDFG species of special concern).

Other sensitive wildlife species that are candidates for federal listing that have not been previously recorded, but may be present in the area of the proposed alignment, include the San Joaquin valley woodrat, riparian brush rabbit, greater western mastiff bat, small-footed myotis bat, long-eared myotis bat, fringed myotis bat, long-legged myotis bat, Yuma myotis bat, Pacific western big-eared bat, Bells sage sparrow, western burrowing owl, ferruginous hawk, mountain plover, little willow flycatcher, white-faced ibis, silvery legless lizard, southwestern pond turtle, San Joaquin whipsnake, California horned lizard, western spadefoot toad, green sturgeon, river lamprey, Kern brook lamprey, Pacific lamprey, longfin smelt, Antioch Dunes anthicid beetle, Sacramento anthicid beetle, and molestan blister beetle.

VEGETATION

Vegetation along the proposed alignment consists of 1,850 acres of agricultural lands, 580 acres of disturbed/marsh lands (which include the previously excavated canal alignment), 80 acres of grasslands, 50 acres of marsh, 55 acres of disturbed lands, and 40 acres of riparian habitat.

Sensitive and Listed Plant Species

Federal- or State-listed plants that are known to occur in or around the area of the proposed Isolated Facility include Mason's lilaeopsis (federal candidate, State rare), Delta button-celery (federal candidate and State endangered), Boggs Lake hedge-hyssop (State endangered), and slender orcutt grass (proposed federal threatened, State endangered).

Candidate plant species for federal listing that may occur in the project area include Suisun Marsh aster, slough thistle, caper-fruited tropidocarpum, San Joaquin saltbush, Delta tule pea, recurved larkspur, and Sanford's arrowhead.

Additional plants listed by the California Native Plant Society as being rare, threatened, or endangered in California and elsewhere could also be affected by the proposed Isolated Facility. These plants include big tarweed, Wright's trichocoronis, dwarf downingia, legenere, alkali milk vetch, Ferris's milk-vetch, marsh skullcap, California hibiscus, heartscale, Delta mudwort, and bristly sedge.

Special-status habitats that may be found along or near the area of the proposed Isolated Facility include valley sink scrub (see wetlands), northern hardpan vernal pool (see wetlands), alkali meadow, coastal and valley freshwater marsh (see wetlands), great valley mixed riparian forest, and valley oak woodland.

Wetlands

Within the area that would be affected by the proposed Isolated Facility there are approximately 44 miles of farmed wetlands abutting the conveyance, 15 acres of emergent seasonally flooded wetlands (shallow marsh), 10 acres of forested wetlands, 30 acres of tidal wetlands, 15 acres of shrub-scrub wetlands, 2 acres of emergent, permanently flooded wetlands, 10 acres of emergent-seldom flooded wetlands (deep marsh), 5 acres of open water, seldom flooded wetlands, and 25 acres of permanently flooded-excavated wetlands (previously excavated canal alignment). The proposed Isolated Facility would cross Disappointment Slough, Telephone Cut, the Stockton Deep Water Channel, San Joaquin River, Middle River, Old River, Beaver Slough, and Hog Slough. It would also cross one farm pond, eight areas of open water (artificially flooded wetlands), five areas of deep marsh, and four areas of excavated emergent wetlands.

Three special-status wetland habitats, northern hardpan vernal pool, alkali meadow, and coastal and valley freshwater marsh could be affected by the proposed conveyance.

CULTURAL RESOURCES

The proposed alignment of the Isolated Facility may affect a total of 16 known cultural resource sites.

Four non-significant prehistoric sites could be affected. Two of these sites are identified solely on the basis of soil color and tests for calcium deposits. The other two lack any descriptive data and have inadequate location information.

Eleven significant prehistoric sites could be affected. Seven have human remains, in some cases with a midden deposit; four have a midden deposit with no known human remains.

One significant historic site, the railroad grade of the Walnut Grove Branch Line, has been determined eligible for listing on the National Register of Historic Places (NRHP). Also, one ethnographic site, Plains Miwok Villages, correlates with two of the prehistoric archaeological sites. No other ethnographic sites or traditional cultural properties are recorded.

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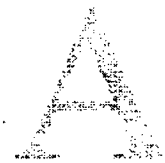

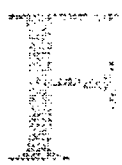

Table 1
SUMMARY OF PHYSICAL CHARACTERISTICS
ISOLATED DELTA CONVEYANCE FACILITY

DESCRIPTION	5,000 cfs	10,000 cfs	15,000 cfs
Intake Facilities			
Trashrack (quantity)	6	12	18
Fish Screens (quantity)	6	12	18
Pumping Plants			
11 Pumps (1 standby) (capacity per unit - cfs)	500 cfs	1,000 cfs	1,500 cfs
Total Dynamic Head (feet)	10	10	10
Total Plant Horsepower (hp)	8,360	16,720	25,080
Earth Canal			
Length (miles)	44	44	44
Type	Earth Section	Earth Section	Earth Section
Top Width (feet)	337	442	513
Bottom Width (feet)	60	100	140
Depth	27	35	36
Side Slopes	3:1, 8:1	3:1, 8:1	3:1, 8:1
Excavation Volume (million cubic yards)	36.0	54.7	69.4
Compacted Embankment Volume (million cubic yards)	22.3	28.1	31.0
Right-of-way (acres)	5,330	5,330	5,330
Siphons			
Mokelumne River			
Length (feet)	730	730	730
Boxes	3 - 26' x 26'	4 - 30' x 30'	6 - 30' x 30'
San Joaquin River			
Length (feet)	712	712	712
Boxes	3 - 26' x 26'	4 - 30' x 30'	6 - 30' x 30'
Old River			
Length (feet)	580	580	580
Boxes	3 - 26' x 26'	4 - 30' x 30'	6 - 30' x 30'
Middle River			
Length (feet)	730	730	730
Boxes	3 - 26' x 26'	4 - 30' x 30'	6 - 30' x 30'
14-Mile Slough			
Length (feet)	375	375	375
Boxes	3 - 26' x 26'	4 - 30' x 30'	6 - 30' x 30'
White Slough			
Length (feet)	205	205	205
Boxes	3 - 26' x 26'	4 - 30' x 30'	6 - 30' x 30'
Sycamore Slough			
Length (feet)	160	160	160
Boxes	3 - 26' x 26'	4 - 30' x 30'	6 - 30' x 30'
Hog Slough			
Length (feet)	190	190	190
Boxes	3 - 26' x 26'	4 - 30' x 30'	6 - 30' x 30'
Beaver Slough			
Length (feet)	385	385	385
Boxes	3 - 26' x 26'	4 - 30' x 30'	6 - 30' x 30'
Lost Slough			
Length (feet)	250	250	250
Boxes	3 - 26' x 26'	4 - 30' x 30'	6 - 30' x 30'
Snodgrass Slough			
Length (feet)	225	225	225
Boxes	3 - 26' x 26'	4 - 30' x 30'	6 - 30' x 30'

Table 2a
ESTIMATED CAPITAL COSTS
ISOLATED DELTA CONVEYANCE FACILITY - 5,000 CFS ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT*	USBR INDEX OCT. 1964	USBR INDEX OCT. 1996	UNIT COST OCT. 1964	UNIT COST OCT. 1996	TOTAL COST OCT. 1996	COST REFERENCE
I. INTAKE FACILITIES								1
Intake Facility From Sacramento River	JOB	LS				$55,070,000	$55,070,000	1
Fish Screening Facility	5,000	CFS				$10,000	$50,000,000	
Miscellaneous Cost @ 20%							$21,014,000	
SUBTOTAL INTAKE FACILITIES							$126,084,000	
II. BRIDGES								
State Hwy. 24	14,700	SF				$100	$1,470,000	3
State Hwy. 12	14,700	SF				$100	$1,470,000	3
State Hwy. 4	14,700	SF				$100	$1,470,000	3
Tracy Road	14,700	SF				$100	$1,470,000	3
Lambert Road	10,500	SF				$100	$1,050,000	3
Laurel Lane	10,500	SF				$100	$1,050,000	3
Walnut Grove Road	10,500	SF				$100	$1,050,000	3
Peltier Road	10,500	SF				$100	$1,050,000	3
Woodbridge Road	10,500	SF				$100	$1,050,000	3
Atherton Road	10,500	SF				$100	$1,050,000	3
McDonal Road	10,500	SF				$100	$1,050,000	3
Calpack Road	10,500	SF				$100	$1,050,000	3
Bonatti Road	10,500	SF				$100	$1,050,000	3
Middle River O & M Road	10,500	SF				$100	$1,050,000	3
Southern Pacific R. R.	JOB	LS	43	226	$578,300	$3,039,437	$3,039,437	2
Western Pacific R. R.	JOB	LS	43	226	$573,000	$3,011,581	$3,011,581	2
A. T. & S. F. R. R. - Main Line	JOB	LS	43	226	$672,000	$3,531,907	$3,531,907	2
SUBTOTAL BRIDGES							$25,962,925	
III. CULVERTS (2)								
Concrete Including Rebar and Earthworks	285	CY				$600	$171,000	3
108" Dia. RCP	3,420	LF				$324	$1,108,080	3
Intake Structures	JOB	LS	45	213	$102,400	$484,693	$484,693	2
Riprap	3,400	CY				$50	$170,000	3
SUBTOTAL CULVERTS							$1,933,773	
IV. PUMPING PLANT								
5,000 cfs, TDH - 10 feet, HP - 8,360)	JOB	LS				29,902,000	$29,902,000	3
SUBTOTAL PUMPING PLANT							$29,902,000	

Table 2a
ESTIMATED CAPITAL COSTS
ISOLATED DELTA CONVEYANCE FACILITY - 5,000 CFS ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 1964	USBR INDEX OCT. 1996	UNIT COST OCT. 1964	UNIT COST OCT. 1996	TOTAL COST OCT. 1996	COST REFERENCE
V. EARTH CANAL								
Excavation	36,018,000	CY				$2.00	$72,036,000	3
Compacted Embankment	22,278,000	CY				$0.80	$17,822,400	3
Common Embankment	4,802,000	CY				$0.50	$2,401,000	3
Borrow	2,201,000	CY				$5.00	$11,005,000	3
Rights of Way	5,330	AC				$5,000	$26,650,000	
Relocation of Existing Property	JOB	LS	40	217	$10,616,000	$57,591,800	$57,591,800	3
Fencing	464,000	LF				$5.00	$2,320,000	3
SUBTOTAL EARTH CANAL							$189,826,200	
VI. MOKELUMNE RIVER SIPHON								
3-26'X26' Concrete Box Including Rebar & Earthwork	15,600	CY				$600	$9,360,000	3
Transitions Concrete	6,400	CY				$600	$3,840,000	3
Riprap	18,000	CY				$50.00	$900,000	3
Sand and Gravel Bedding	6,000	CY				$50.00	$300,000	3
Channel Excavation	316,200	CY				$2.00	$632,400	3
Compacted Embankment	191,400	CY				$0.80	$153,120	3
Temporary Dikes	30,800	CY				$4.00	$123,200	3
Fill in Old River Bed	125,000	CY				$2.00	$250,000	3
Level Abandoned Levee	139,000	CY				$2.00	$278,000	3
Dewatering and Maintenance of Site	JOB	LS	40	217	$235,000	$1,274,875	$1,274,875	2
SUBTOTAL MOKELUMNE RIVER SIPHON							$17,111,595	
VII. SAN JOAQUIN RIVER SIPHON								
Dewatering and Pumping	JOB	LS	43	212	$206,000	$1,015,628	$1,015,628	2
Strip and Waste Peat	44,000	CY				2.00	$88,000	3
3-26'X26' Concrete Box Including Rebar & Earthwork	15,130	CY				$600	$9,078,000	3
Transitions Concrete	6,400	CY				$600	$3,840,000	3
Trench Excavation	439,000	CY				$2.00	$878,000	3
Spoil Unsuitable Material	54,000	CY				$2.00	$108,000	3
Compacted Embankment	24,200	CY				$0.80	$19,360	3
Riprap	13,100	CY				$50.00	$655,000	3
Gravel Bedding	3,200	CY				$50.00	$160,000	3
Sand Backfill	367,400	CY				$4.00	$1,469,600	3
Open Joint Tile - 6" Dia.	9,200	LF				$2.00	$18,400	3

Table 2a
ESTIMATED CAPITAL COSTS
ISOLATED DELTA CONVEYANCE FACILITY - 5,000 CFS ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 1964	USBR INDEX OCT. 1996	UNIT COST OCT. 1964	UNIT COST OCT. 1996	TOTAL COST OCT. 1996	COST REFERENCE
Gravel Filter	650	CY				$50.00	$32,500	3
Sheet Piling	21,000	SF				$25.00	$525,000	3
Timber Piling	250	EA	43	212	$275	$1,356	$339,000	2
Placing Fabricated Barrel Units	JOB	LS	43	212	$505,000	$2,489,767	$2,489,767	2
Casting Basin	JOB	LS	43	212	$650,000	$3,204,651	$3,204,651	2
Slide Gates and Hoists	JOB	LS	43	212	$30,000	$147,907	$147,907	2
SUBTOTAL SAN JOAQUIN RIVER SIPHON							$24,068,813	
VIII. OLD RIVER SIPHON								
3-26'X26' Concrete Box Including Rebar & Earthwork	11,700	CY				$600	$7,020,000	3
Transitions Concrete	6,400	CY				$600	$3,840,000	3
Compacted Embankment	90,000	CY				$2.80	$252,000	3
Sand and Gravel Bedding	4,000	CY				$50.00	$200,000	3
Riprap	16,000	CY				$50.00	$800,000	3
Replace Levee Road	1,100	LF	43	237	$4.20	$23.00	$25,300	2
Cofferdams (2)	72,000	CY				$2.80	$201,600	3
Remove Old Levees and Two Cofferdams	204,000	CY				$1.50	$306,000	3
Bypass Channel	JOB	LF	43	212	$240,000	$1,183,256	$1,183,256	2
Dewatering	JOB	LF	43	212	$235,000	$1,158,605	$1,158,605	2
SUBTOTAL OLD RIVER SIPHON							$14,986,761	

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 1995	USBR INDEX OCT. 1996	UNIT COST OCT. 1995	UNIT COST OCT. 1996	TOTAL COST OCT. 1996	COST REFERENCE
IX. MIDDLE RIVER SIPHON								
Temporary River Realignment	JOB	LS	189	199	$7,149,000	$7,527,254	$7,527,254	4
Dewatering	JOB	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar Earthworks	15,600	CY				$600	$9,360,000	3
Riprap	42,852	TON	181	181	$27.00	$27.00	$1,157,004	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4
Inlet and Outlet Transitions - Concrete	6,400	CY				$600	$3,840,000	3
Miscellaneous @ 20%							$4,429,100	
SUBTOTAL MIDDLE RIVER SIPHON							$26,574,598	

Table 2a
ESTIMATED CAPITAL COSTS
ISOLATED DELTA CONVEYANCE FACILITY - 5,000 CFS ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT*	USBR INDEX OCT. 1995	USBR INDEX OCT. 1996	UNIT COST OCT. 1995	UNIT COST OCT. 1996	TOTAL COST OCT. 1996	COST REFERENCE
X. 14-MILE SLOUGH SIPHON								
Temporary River Realignment	JOB	LS	189	199	$2,466,000	$2,596,476	$2,596,476	4
Dewatering	JOB	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar Earthworks	6,500	CY				$600	$3,900,000	3
Riprap	2,444	TON	181	181	$27.00	$27.00	$65,988	4
Access Road	0.27	TON	208	219	$500,000	$526,442	$142,139	4
Inlet and Outlet Transitions - Concrete	6,400	CY				$600	$3,840,000	3
Miscellaneous @ 20%							$2,132,741	
SUBTOTAL 14-MILE SLOUGH SIPHON							$12,796,445	
XI. WHITE SLOUGH SIPHON								
Temporary River Realignment	JOB	LS	189	199	$912,000	$960,254	$960,254	4
Dewatering	JOB	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar and Earthworks	2,600	CY				$600	$1,560,000	3
Riprap	15,630	TON	181	181	$27.00	$27.00	$422,010	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4
Inlet and Outlet Transitions - Concrete	6,400	CY				$600	$3,840,000	3
Miscellaneous @ 20%							$1,408,701	
SUBTOTAL WHITE SLOUGH SIPHON							$8,452,205	
XII. SYCAMORE SLOUGH SIPHON								
Temporary River Realignment	JOB	LS	189	199	$502,000	$528,561	$528,561	4
Dewatering	JOB	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar and Earthworks	1,300	CY				$600	$780,000	3
Riprap	13,296	TON	181	181	$27.00	$27.00	$358,992	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4
Inlet and Outlet Transitions - Concrete	6,400	CY				$600	$3,840,000	3
Miscellaneous @ 20%							$1,153,759	
SUBTOTAL SYCAMORE SLOUGH SIPHON							$6,922,552	
XIII. HOG SLOUGH SIPHON								
Temporary River Realignment	JOB	LS	189	199	$742,000	$781,259	$781,259	4
Dewatering	JOB	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar and Earthworks	1,950	CY				$600	$1,170,000	3
Riprap	14,852	TON	181	181	$27.00	$27.00	$401,004	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4

Table 2a
ESTIMATED CAPITAL COSTS
ISOLATED DELTA CONVEYANCE FACILITY - 5,000 CFS ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 1995	USBR INDEX OCT. 1996	UNIT COST OCT. 1995	UNIT COST OCT. 1996	TOTAL COST OCT. 1996	COST REFERENCE
Inlet and Outlet Transitions - Concrete	6,400	CY				$600	$3,840,000	3
Miscellaneous @ 20%							$1,290,701	
SUBTOTAL HOG SLOUGH SIPHON							$7,744,204	
XIV. BEAVER SLOUGH SIPHON								
Temporary River Realignment	JOB	LS	189	199	$2,533,000	$2,667,021	$2,667,021	4
Dewatering	JOB	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar and Earthwork	6,500	CY				$600	$3,900,000	3
Riprap	24,963	TON	181	181	$27.00	$27.00	$674,001	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4
Inlet and Outlet Transitions - Concrete	6,400	CY				$600	$3,840,000	3
Miscellaneous @ 20%							$2,268,452	
SUBTOTAL BEAVER SLOUGH SIPHON							$13,610,714	
XV. LOST SLOUGH SIPHON								
Dewatering	JOB	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar and Earthwork	3,250	CY				$600	$1,950,000	3
Riprap	17,963	TON	181	181	$27.00	$27.00	$485,001	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4
Inlet and Outlet Transitions - Concrete	6,400	CY				$600	$3,840,000	3
Miscellaneous @ 20%							$1,307,248	
SUBTOTAL LOST SLOUGH SIPHON							$7,843,489	
XVI. SNODGRASS SLOUGH SIPHON								
Temporary River Realignment	JOB	LS	189	199	$950,000	$1,000,265	$1,000,265	4
Dewatering	JOB	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar and Earthworks	2,600	CY				$600	$1,560,000	3
Riprap	16,667	TON	181	181	$27.00	$27.00	$450,009	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4
Inlet and Outlet Transitions - Concrete	6,400	CY				$600	$3,840,000	3
Miscellaneous @ 20%							$1,422,303	
SUBTOTAL SNODGRASS SLOUGH SIPHON							$8,533,817	

Table 2a
ESTIMATED CAPITAL COSTS
ISOLATED DELTA CONVEYANCE FACILITY - 5,000 CFS ALTERNATIVE

DESCRIPTION	QUANTITY						TOTAL COST OCT. 1996	
SUBTOTAL COST ITEMS ISOLATED CONVEYANCE FACILITY - 5,000 CFS ALTERNATIVE							$522,400,000	
CONTINGENCIES @ 20 %							$104,500,000	
ESTIMATED CONSTRUCTION COST							$626,900,000	
ENG., LEGAL, AND ADM. @ 35%							$219,400,000	
ESTIMATED CAPITAL COST							$846,300,000	
ESTIMATED CAPITAL COST RANGE								
LOW (-10 %)							$762,000,000	
HIGH (+15 %)							$973,000,000	

Footnote:
aLS=lump sum; HP=horsepower; CY=cubic yard; LF=linear foot; SF=square foot; EA=each

Cost References:
1. CALFED
2. U.S. Bureau of Reclamation, *Peripheral Canal - Reconnaissance Estimate*, October 1964.
3. Cost developed by Bookman-Edmonston Engineering.
4. California Department of Water Resources, Civil Design Branch, Division of Design and Construction, *Isolated Delta Conveyance*, September 1995.

Table 2b
ESTIMATED CAPITAL COSTS
ISOLATED DELTA CONVEYANCE FACILITY - 10,000 CFS ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 1964	USBR INDEX OCT. 1996	UNIT COST OCT. 1964	UNIT COST OCT. 1996	TOTAL COST OCT. 1996	COST REFERENCE
I. INTAKE FACILITIES								
Intake Facility From Sacramento River	JOB	LS				$54,091,000	$54,091,000	1
Fish Screens	10,000	CFS				$10,000	$100,000,000	1
Miscellaneous Cost @ 20%							$30,818,200	
SUBTOTAL INTAKE FACILITIES							$184,909,200	
II. BRIDGES								
State Hwy. 24	19,320	SF				$100	$1,932,000	3
State Hwy. 12	19,320	SF				$100	$1,932,000	3
State Hwy. 4	19,320	SF				$100	$1,932,000	3
Tracy Road	19,320	SF				$100	$1,932,000	3
Lambert Road	13,800	SF				$100	$1,380,000	3
Laurel Lane	13,800	SF				$100	$1,380,000	3
Walnut Grove Road	13,800	SF				$100	$1,380,000	3
Peltier Road	13,800	SF				$100	$1,380,000	3
Woodbridge Road	13,800	SF				$100	$1,380,000	3
Atherton Road	13,800	SF				$100	$1,380,000	3
McDonal Road	13,800	SF				$100	$1,380,000	3
Calpack Road	13,800	SF				$100	$1,380,000	3
Bonatti Road	13,800	SF				$100	$1,380,000	3
Middle River O & M Road	13,800	SF				$100	$1,380,000	3
Southern Pacific R. R.	LS	LS	43	226	$578,300	$3,039,437	$3,039,437	2
Western Pacific R. R.	LS	LS	43	226	$573,000	$3,011,581	$3,011,581	2
A. T. & S. F. R. R. - Main Line	LS	LS	43	226	$672,000	$3,531,907	$3,531,907	2
SUBTOTAL BRIDGES							$31,110,925	
III. CULVERTS (2)								
Concrete Including Rebar and Earthworks	285	CY				$600	$171,000	3
108" Dia. RCP	3,420	LF				$324	$1,108,080	3
Intake Structures	LS	LS	45	213	$102,400	$484,693	$484,693	2
Riprap	3,400	CY				$50.00	$170,000	3
SUBTOTAL CULVERTS							$1,933,773	
IV. PUMPING PLANT								
Q = 10,000 cfs, TDH = 10 feet, HP = 16,720	JOB	LS				$45,324,000	$45,324,000	3
SUBTOTAL PUMPING PLANT							$45,324,000	

Table 2b
ESTIMATED CAPITAL COSTS
ISOLATED DELTA CONVEYANCE FACILITY - 10,000 CFS ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT*	USBR INDEX OCT. 1964	USBR INDEX OCT. 1996	UNIT COST OCT. 1964	UNIT COST OCT. 1996	TOTAL COST OCT. 1996	COST REFERENCE
V. EARTH CANAL								
Excavation	54,651,000	CY				$2.00	$109,302,000	3
Compacted Embankment	28,067,000	CY				$0.80	$22,453,600	3
Common Embankment	5,817,000	CY				$0.50	$2,908,500	3
Rights-Of-Way	5,330	AC				$5,000	$26,650,000	3
Relocation of Existing Property	LS	LS	40	217	$10,616,000	$57,591,800	$57,591,800	2
Fencing	464,000	LF				$5.00	$2,320,000	3
SUBTOTAL EARTH CANAL							$221,225,900	
VI. MOKELUMNE RIVER SIPHON								
4-30'x30" Concrete Box Including Rebar & Earthwork	22,500	CY				$600	$13,500,000	3
Transitions Concrete	6,810	CY				$600	$4,086,000	3
Riprap	23,400	CY				$50.00	$1,170,000	3
Sand and Gravel Bedding	7,800	CY				$50.00	$390,000	3
Channel Excavation	411,000	CY				$2.00	$822,000	3
Compacted Embankment	248,800	CY				$0.80	$199,040	3
Temporary Dikes	40,000	CY				$4.00	$160,000	3
Fill in Old River Bed	162,500	CY				$2.00	$325,000	3
Level Abandoned Levee	180,700	CY				$2.00	$361,400	3
Dewatering and Maintenance of Site	LS	LS	40	217	$235,000	$1,274,875	$1,274,875	2
SUBTOTAL MOKELUMNE RIVER SIPHON							$22,288,315	
VII. SAN JOAQUIN RIVER SIPHON								
Dewatering and Pumping	LS	LS	43	212	$206,000	$1,015,628	$1,015,628	2
Strip and Waste Peat	57,200	CY				$2.00	$114,400	3
4-30'x30' Concrete Box Including Rebar & Earthwork	21,830	CY				$600	$13,098,000	3
Transitions Concrete	6,810	CY				$600	$4,086,000	3
Trench Excavation	571,000	CY				$2.00	$1,142,000	3
Spoil Unsuitable Material	70,000	CY				$2.00	$140,000	3
Compacted Embankment	31,500	CY				$0.80	$25,200	3
Riprap	17,000	CY				$50.00	$850,000	3
Gravel Bedding	4,200	CY				$50.00	$210,000	3
Sand Backfill	477,600	CY				$4.00	$1,910,400	3
Open Joint Tile - 6" Dia.	12,000	LF				$2.00	$24,000	3
Gravel Filter	850	CY				$50.00	$42,500	3

Table 2b
ESTIMATED CAPITAL COSTS
ISOLATED DELTA CONVEYANCE FACILITY - 10,000 CFS ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 1964	USBR INDEX OCT. 1996	UNIT COST OCT. 1964	UNIT COST OCT. 1996	TOTAL COST OCT. 1996	COST REFERENCE
Sheet Piling	27,300	SF				$25.00	$682,500	3
Timber Piling	330	EA	43	212	$275	$1,356	$447,480	2
Placing Fabricated Barrel Units	LS	LS				$3,237,000	$3,237,000	3
Casting Basin	LS	LS				$4,166,000	$4,166,000	3
Slide Gates and Hoists	LS	LS				$192,000	$192,000	3
SUBTOTAL SAN JOAQUIN RIVER SIPHON							$31,383,108	
VIII. OLD RIVER SIPHON								
4-30'x30' Concrete Box Including Rebar & Earthwork	16,880	CY				$600	$10,128,000	3
Transitions Concrete	6,810	CY				$600	$4,086,000	3
Compacted Embankment	117,000	CY				$0.80	$93,600	3
Sand and Gravel Bedding	5,200	CY				$50.00	$260,000	3
Riprap	21,000	CY				$50.00	$1,050,000	3
Replace Levee Road	1,100	LF	43	237	$4.20	$23.00	$25,300	2
Cofferdams (2)	72,000	CY				$2.80	$201,600	3
Remove Old Levees and Two Cofferdams	204,000	CY				$1.50	$306,000	3
Bypass Channel	LS	LF	43	212	$240,000	$1,183,256	$1,183,256	2
Dewatering	LS	LF	43	212	$235,000	$1,158,605	$1,158,605	2
SUBTOTAL OLD RIVER SIPHON							$18,492,361	

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 1995	USBR INDEX OCT. 1996	UNIT COST OCT. 1995	UNIT COST OCT. 1996	TOTAL COST OCT. 1996	COST REFERENCE
IX. MIDDLE RIVER SIPHON								
Temporary River Realignment	LS	LS	189	199	$7,149,000	$7,527,254	$7,527,254	4
Dewatering	LS	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar Earthworks	22,500	CY				$600	$13,500,000	3
Riprap	55,700	TON	181	181	$27.00	$27.00	$1,503,900	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4
Inlet and Outlet Transitions - Concrete	6,810	CY				$600	$4,086,000	3
Miscellaneous @ 20%							$5,375,679	
SUBTOTAL MIDDLE RIVER SIPHON							$32,254,073	

Table 2b
ESTIMATED CAPITAL COSTS
ISOLATED DELTA CONVEYANCE FACILITY - 10,000 CFS ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT*	USBR INDEX OCT. 1995	USBR INDEX OCT. 1996	UNIT COST OCT. 1995	UNIT COST OCT. 1996	TOTAL COST OCT. 1996	COST REFERENCE
X. 14-MILE SLOUGH SIPHON								
Temporary River Realignment	LS	LS	189	199	$2,466,000	$2,596,476	$2,589,000	4
Dewatering	LS	LS	178	212	$100,000	$119,101	$119,000	4
Siphon - Concrete Including Rebar Earthworks	9,380	CY				$600	$5,628,000	3
Riprap	3,180	TON	181	181	$27.00	$27.00	$86,000	4
Access Road	0.27	TON	208	219	$500,000	$526,442	$142,000	4
Inlet and Outlet Transitions - Concrete	6,810	CY				$600	$4,086,000	3
Miscellaneous @ 20%							$2,530,000	
SUBTOTAL 14-MILE SLOUGH SIPHON							$15,180,000	
XI. WHITE SLOUGH SIPHON								
Temporary River Realignment	LS	LS	189	199	$912,000	$960,254	$960,254	4
Dewatering	LS	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar and Earthworks	3,750	CY				$600	$2,250,000	3
Riprap	20,300	TON	181	181	$27.00	$27.00	$548,100	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4
Inlet and Outlet Transitions - Concrete	6,810	CY				$600	$4,086,000	3
Miscellaneous @ 20%							$1,621,119	
SUBTOTAL WHITE SLOUGH SIPHON							$9,726,713	
XII. SYCAMORE SLOUGH SIPHON								
Temporary River Realignment	LS	LS	189	199	$502,000	$528,561	$528,561	4
Dewatering	LS	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar and Earthworks	1,875	CY				$600	$1,125,000	3
Riprap	17,300	TON	181	181	$27.00	$27.00	$467,100	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4
Inlet and Outlet Transitions - Concrete	6,810	CY				$600	$4,086,000	3
Miscellaneous @ 20%							$1,293,580	
SUBTOTAL SYCAMORE SLOUGH SIPHON							$7,761,482	
XIII. HOG SLOUGH SIPHON								
Temporary River Realignment	LS	LS	189	199	$742,000	$781,259	$781,259	4
Dewatering	LS	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar and Earthworks	2,813	CY				$600	$1,687,800	3
Riprap	19,300	TON	181	181	$27.00	$27.00	$521,100	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4

Table 2b
ESTIMATED CAPITAL COSTS
ISOLATED DELTA CONVEYANCE FACILITY - 10,000 CFS ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 1995	USBR INDEX OCT. 1996	UNIT COST OCT. 1995	UNIT COST OCT. 1996	TOTAL COST OCT. 1996	COST REFERENCE
Inlet and Outlet Transitions - Concrete	6,810	CY				$600	$4,086,000	3
Miscellaneous @ 20%							$1,467,480	
SUBTOTAL HOG SLOUGH SIPHON							$8,804,879	
XIV. BEAVER SLOUGH SIPHON								
Temporary River Realignment	LS	LS	189	199	$2,533,000	$2,667,021	$2,667,021	4
Dewatering	LS	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar and Earthwork	9,375	CY				$600	$5,625,000	3
Riprap	32,500	TON	181	181	$27.00	$27.00	$877,500	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4
Inlet and Outlet Transitions - Concrete	6,810	CY				$600	$4,086,000	3
Miscellaneous @ 20%							$2,703,352	
SUBTOTAL BEAVER SLOUGH SIPHON							$16,220,114	
XV. LOST SLOUGH SIPHON								
Dewatering	LS	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar and Earthwork	4,690	CY				$600	$2,814,000	3
Riprap	23,400	TON	181	181	$27.00	$27.00	$631,800	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4
Inlet and Outlet Transitions - Concrete	6,810	CY				$600	$4,086,000	3
Miscellaneous @ 20%							$1,558,608	
SUBTOTAL LOST SLOUGH SIPHON							$9,351,648	
XVI. SNODGRASS SLOUGH SIPHON								
Temporary River Realignment	LS	LS	189	199	$950,000	$1,000,265	$1,000,265	4
Dewatering	LS	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar and Earthworks	3,750	CY				$600	$2,250,000	3
Riprap	21,700	TON	181	181	$27.00	$27.00	$585,900	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4
Inlet and Outlet Transitions - Concrete	6,810	CY				$600	$4,086,000	3
Miscellaneous @ 20%							$1,636,681	
SUBTOTAL SNODGRASS SLOUGH SIPHON							$9,820,086	

Table 2b
ESTIMATED CAPITAL COSTS
ISOLATED DELTA CONVEYANCE FACILITY - 10,000 CFS ALTERNATIVE

DESCRIPTION	QUANTITY						TOTAL COST OCT. 1996	
SUBTOTAL COST ITEMS ISOLATED CONVEYANCE FACILITY - 10,000 CFS ALTERNATIVE							**$665,800,000**	
CONTINGENCIES @ 20 %							$133,200,000	
ESTIMATED CONSTRUCTION COST							$799,000,000	
ENG., LEGAL, AND ADM. @ 35%							$279,700,000	
ESTIMATED CAPITAL COST							**$1,078,700,000**	
ESTIMATED CAPITAL COST RANGE								
LOW (-10 %)							$971,000,000	
HIGH (+15 %)							$1,241,000,000	

Footnote:
aLS=lump sum; HP=horsepower; CY=cubic yard; LF=linear foot; SF=square foot; EA=each

Cost References:

1. CALFED
2. U.S. Bureau of Reclamation, *Peripheral Canal - Reconnaissance Estimate*, October 1964.
3. Cost developed by Bookman-Edmonston Engineering.
4. California Department of Water Resources, Civil Design Branch, Division of Design and Construction, *Isolated Delta Conveyance*, September 1995.

Table 2c
ESTIMATED CAPITAL COSTS
ISLOLATED DELTA CONVEYANCE FACILITY - 15,000 CFS ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 1964	USBR INDEX OCT. 1996	UNIT COST OCT. 1964	UNIT COST OCT. 1996	TOTAL COST OCT. 1996	COST REFERENCE
I. INTAKE FACILITIES								
Intake Facilities From Sacramento River	JOB	LS				$45,906,000	$45,906,000	1
Fish Screens	15,000	CFS				$10,000	$150,000,000	1
Miscellaneous Cost @ 20%							$39,181,200	
SUBTOTAL INTAKE FACILITIES							$235,087,200	
II. BRIDGES								
State Hwy. 24	22,680	SF				$100	$2,268,000	3
State Hwy. 12	22,680	SF				$100	$2,268,000	3
State Hwy. 4	22,680	SF				$100	$2,268,000	3
Tracy Road	22,680	SF				$100	$2,268,000	3
Lambert Road	16,200	SF				$100	$1,620,000	3
Laurel Lane	16,200	SF				$100	$1,620,000	3
Walnut Grove Road	16,200	SF				$100	$1,620,000	3
Peltier Road	16,200	SF				$100	$1,620,000	3
Woodbridge Road	16,200	SF				$100	$1,620,000	3
Atherton Road	16,200	SF				$100	$1,620,000	3
McDonal Road	16,200	SF				$100	$1,620,000	3
Calpack Road	16,200	SF				$100	$1,620,000	3
Bonatti Road	16,200	SF				$100	$1,620,000	3
Middle River O & M Road	16,200	SF				$100	$1,620,000	3
Southern Pacific R. R.	JOB	LS	43	226	$578,300	$3,039,437	$3,039,437	2
Western Pacific R. R.	JOB	LS	43	226	$573,000	$3,011,581	$3,011,581	2
A. T. & S. F. R. R. - Main Line	JOB	LS	43	226	$672,000	$3,531,907	$3,531,907	2
SUBTOTAL BRIDGES							$34,854,925	
III. CULVERTS (2)								
Concrete Including Rebar and Earthworks	285	CY				$600	$171,000	3
108" Dia. RCP	3,420	LF				$324	$1,108,080	3
Intake Structures	JOB	LS	45	213	$102,400	$484,693	$484,693	2
Riprap	3,400	CY				$50.00	$170,000	3
SUBTOTAL CULVERTS							$1,933,773	
IV. PUMPING PLANT								
Q = 15,000 cfs, TDH = 10 feet, HP = 25,080	JOB	LS				$57,807,000	$57,807,000	2
SUBTOTAL PUMPING PLANT							$57,807,000	

Table 2c
ESTIMATED CAPITAL COSTS
ISLOLATED DELTA CONVEYANCE FACILITY - 15,000 CFS ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 1964	USBR INDEX OCT. 1996	UNIT COST OCT. 1964	UNIT COST OCT. 1996	TOTAL COST OCT. 1996	COST REFERENCE
V. EARTH CANAL								
Excavation	69,373,000	CY				$2.00	$138,746,000	3
Compacted Embankment	31,002,000	CY				$0.80	$24,801,600	3
Common Embankment	6,403,000	CY				$0.50	$3,201,500	3
Rights-Of-Way	5,330	AC				$5,000	$26,650,000	3
Relocation of Existing Property	JOB	LS	40	217	$10,616,000	$57,591,800	$57,591,800	2
Fencing	464,000	LF				$5.00	$2,320,000	3
SUBTOTAL EARTH CANAL							$253,310,900	
VI. MOKELUMNE RIVER SIPHON								
6-30'x30" Concrete Box Including Rebar & Earthwork	33,600	CY				$600	$20,160,000	3
Transitions Concrete	7,000	CY				$600	$4,200,000	3
Riprap	27,180	CY				$50.00	$1,359,000	3
Sand and Gravel Bedding	9,060	CY				$50.00	$453,000	3
Channel Excavation	477,500	CY				$2.00	$955,000	3
Compacted Embankment	289,000	CY				$0.80	$231,200	3
Temporary Dikes	46,500	CY				$4.00	$186,000	3
Fill in Old River Bed	189,000	CY				$2.00	$378,000	3
Level Abandoned Levee	210,000	CY				$2.00	$420,000	3
Dewatering and Maintenance of Site	JOB	LS	40	217	$235,000	$1,274,875	$1,274,875	2
SUBTOTAL MOKELUMNE RIVER SIPHON							$29,617,075	
VII. SAN JOAQUIN RIVER SIPHON								
Dewatering and Pumping	JOB	LS	43	212	$206,000	$1,015,628	$1,015,628	2
Strip and Waste Peat	66,400	CY				$2.00	$132,800	3
6-30'x30' Concrete Box Including Rebar & Earthwork	32,590	CY				$600	$19,554,000	3
Transitions Concrete	7,000	CY				$600	$4,200,000	3
Trench Excavation	663,000	CY				$2.00	$1,326,000	3
Spoil Unsuitable Material	82,000	CY				$2.00	$164,000	3
Compacted Embankment	37,000	CY				$0.80	$29,600	3
Riprap	19,800	CY				$50.00	$990,000	3
Gravel Bedding	4,800	CY				$50.00	$240,000	3
Sand Backfill	554,800	CY				$4.00	$2,219,200	3
Open Joint Tile - 6" Dia.	13,900	LF				$2.00	$27,800	3
Gravel Filter	980	CY				$50.00	$49,000	3

Table 2c
ESTIMATED CAPITAL COSTS
ISLOLATED DELTA CONVEYANCE FACILITY - 15,000 CFS ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 1964	USBR INDEX OCT. 1996	UNIT COST OCT. 1964	UNIT COST OCT. 1996	TOTAL COST OCT. 1996	COST REFERENCE
Sheet Piling	32,000	SF				$25.00	$800,000	3
Timber Piling	380	EA	43	212	$275	$1,356	$515,280	2
Placing Fabricated Barrel Units	JOB	LS				$3,760,000	$3,760,000	2
Casting Basin	JOB	LS				$4,840,000	$4,840,000	2
Slide Gates and Hoists	JOB	LS				$223,000	$223,000	2
SUBTOTAL SAN JOAQUIN RIVER SIPHON							$40,086,308	
VIII. OLD RIVER SIPHON								
6-30'x30' Concrete Box Including Rebar & Earthwork	25,200	CY				$600	$15,120,000	3
Transitions Concrete	7,000	CY				$600	$4,200,000	3
Compacted Embankment	136,000	CY				$0.80	$108,800	3
Sand and Gravel Bedding	6,040	CY				$50.00	$302,000	3
Riprap	24,000	CY				$50.00	$1,200,000	3
Replace Levee Road	1,700	LF	43	237	$4.20	$23.00	$39,100	2
Cofferdams (2)	72,000	CY				$2.80	$201,600	3
Remove Old Levees and Two Cofferdams	204,000	CY				$1.50	$306,000	3
Bypass Channel	JOB	LF	43	212	$240,000	$1,183,256	$1,183,256	2
Dewatering	JOB	LF	43	212	$235,000	$1,158,605	$1,158,605	2
SUBTOTAL OLD RIVER SIPHON							$23,819,361	

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 1995	USBR INDEX OCT. 1996	UNIT COST OCT. 1964	UNIT COST OCT. 1995	TOTAL COST OCT. 1996	COST REFERENCE
IX. MIDDLE RIVER SIPHON								
Temporary River Realignment	JOB	LS	189	199	$7,149,000	$7,527,254	$7,527,254	4
Dewatering	JOB	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar Earthworks	23,560	CY				$600	$14,136,000	3
Riprap	64,710	TON	181	181	$27.00	$27.00	$1,747,170	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4
Inlet and Outlet Transitions - Concrete	7,000	CY				$600	$4,200,000	3
Miscellaneous @ 20%							$5,574,333	
SUBTOTAL MIDDLE RIVER SIPHON							$33,445,997	

Table 2c
ESTIMATED CAPITAL COSTS
ISLOLATED DELTA CONVEYANCE FACILITY - 15,000 CFS ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 1995	USBR INDEX OCT. 1996	UNIT COST OCT. 1964	UNIT COST OCT. 1995	TOTAL COST OCT. 1996	COST REFERENCE
X. 14-MILE SLOUGH SIPHON								
Temporary River Realignment	JOB	LS	189	199	$2,466,000	$2,596,476	$2,596,476	4
Dewatering	JOB	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar Earthworks	9,820	CY				$600	$5,892,000	3
Riprap	3,690	TON	181	181	$27.00	$27.00	$99,630	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4
Inlet and Outlet Transitions - Concrete	7,000	CY				$600	$4,200,000	3
Miscellaneous @ 20%							$2,609,869	
SUBTOTAL 14-MILE SLOUGH SIPHON							$15,659,215	
XI. WHITE SLOUGH SIPHON								
Temporary River Realignment	JOB	LS	189	199	$912,000	$960,254	$960,254	4
Dewatering	JOB	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar and Earthworks	3,930	CY				$600	$2,358,000	3
Riprap	23,600	TON	181	181	$27.00	$27.00	$637,200	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4
Inlet and Outlet Transitions - Concrete	7,000	CY				$600	$4,200,000	3
Miscellaneous @ 20%							$1,683,339	
SUBTOTAL WHITE SLOUGH SIPHON							$10,100,033	
XII. SYCAMORE SLOUGH SIPHON								
Temporary River Realignment	JOB	LS	189	199	$502,000	$528,561	$528,561	4
Dewatering	JOB	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar and Earthworks	1,960	CY				$600	$1,176,000	3
Riprap	20,080	TON	181	181	$27.00	$27.00	$542,160	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4
Inlet and Outlet Transitions - Concrete	7,000	CY				$600	$4,200,000	3
Miscellaneous @ 20%							$1,341,592	
SUBTOTAL SYCAMORE SLOUGH SIPHON							$8,049,553	
XIII. HOG SLOUGH SIPHON								
Temporary River Realignment	JOB	LS	189	199	$742,000	$781,259	$781,259	4
Dewatering	JOB	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar and Earthworks	2,950	CY				$600	$1,770,000	3
Riprap	22,430	TON	181	181	$27.00	$27.00	$605,610	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4

Table 2c
ESTIMATED CAPITAL COSTS
ISLOLATED DELTA CONVEYANCE FACILITY - 15,000 CFS ALTERNATIVE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 1995	USBR INDEX OCT. 1996	UNIT COST OCT. 1964	UNIT COST OCT. 1995	TOTAL COST OCT. 1996	COST REFERENCE
Inlet and Outlet Transitions - Concrete	7,000	CY				$600	$4,200,000	3
Miscellaneous @ 20%							$1,523,622	
SUBTOTAL HOG SLOUGH SIPHON							$9,141,731	
XIV. BEAVER SLOUGH SIPHON								
Temporary River Realignment	JOB	LS	189	199	$2,533,000	$2,667,021	$2,667,021	4
Dewatering	JOB	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar and Earthwork	9,820	CY				$600	$5,892,000	3
Riprap	37,700	TON	181	181	$27.00	$27.00	$1,017,900	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4
Inlet and Outlet Transitions - Concrete	7,000	CY				$600	$4,200,000	3
Miscellaneous @ 20%							$2,807,632	
SUBTOTAL BEAVER SLOUGH SIPHON							$16,845,793	
XV. LOST SLOUGH SIPHON								
Dewatering	JOB	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar and Earthwork	4,910	CY				$600	$2,946,000	3
Riprap	27,100	TON	181	181	$27.00	$27.00	$731,700	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4
Inlet and Outlet Transitions - Concrete	7,000	CY				$600	$4,200,000	3
Miscellaneous @ 20%							$1,627,788	
SUBTOTAL LOST SLOUGH SIPHON							$9,766,728	
XVI. SNODGRASS SLOUGH SIPHON								
Temporary River Realignment	JOB	LS	189	199	$950,000	$1,000,265	$1,000,265	4
Dewatering	JOB	LS	178	212	$100,000	$119,101	$119,101	4
Siphon - Concrete Including Rebar and Earthworks	3,930	CY				$600	$2,358,000	3
Riprap	25,200	TON	181	181	$27.00	$27.00	$680,400	4
Access Road	0.27	MILE	208	219	$500,000	$526,442	$142,139	4
Inlet and Outlet Transitions - Concrete	7,000	CY				$600	$4,200,000	3
Miscellaneous @ 20%							$1,699,981	
SUBTOTAL SNODGRASS SLOUGH SIPHON							$10,199,886	

Table 2c
ESTIMATED CAPITAL COSTS
ISLOLATED DELTA CONVEYANCE FACILITY - 15,000 CFS ALTERNATIVE

DESCRIPTION	QUANTITY						TOTAL COST OCT. 1996	
SUBTOTAL COST ITEMS ISOLATED DELTA CONVEYANCE FACILITY - 15,000 CFS ALTERNATIVE							**$789,700,000**	
CONTINGENCIES @ 20 %							$157,900,000	
ESTIMATED CONSTRUCTION COST							$947,600,000	
ENG., LEGAL, AND ADM. @ 35%							$331,700,000	
ESTIMATED CAPITAL COST							**$1,279,300,000**	
ESTIMATED CAPITAL COST RANGE								
LOW (-10 %)							$1,151,000,000	
HIGH (+15 %)							$1,471,000,000	

Footnote:
aLS=lump sum; HP=horsepower; CY=cubic yard; LF=linear foot; SF=square foot; EA=each

Cost References:
1. CALFED
2. U.S. Bureau of Reclamation, *Peripheral Canal - Reconnaissance Estimate*, October 1964.
3. Cost developed by Bookman-Edmonston Engineering.
4. California Department of Water Resources, Civil Design Branch, Division of Design and Construction, *Isolated Delta Conveyance*, September 1995.

Table 3
SUMMARY OF ESTIMATED CAPITAL COSTS
ISOLATED DELTA CONVEYANCE FACILITY

Cost Item	Estimated Cost ($ Millions)		
	5,000 cfs	10,000 cfs	15,000 cfs
Intake Facilities	$126.1	$184.9	$235.1
Bridges	$26.0	$31.1	$34.9
Culverts	$2.0	$1.9	$1.9
Pumping Plant	$29.9	$45.3	$57.8
Earth Canal	$189.8	$221.2	$253.3
Mokelumne River Siphon	$17.1	$22.3	$29.6
San Joaquin River Siphon	$24.1	$31.4	$40.1
Old River Siphon	$15.0	$18.5	$23.8
Middle River Siphon	$26.6	$32.3	$33.4
14-Mile Slough Siphon	$12.8	$15.2	$15.7
White Slough Siphon	$8.5	$9.7	$10.1
Sycamore Slough Siphon	$6.9	$7.8	$8.0
Hog Slough Siphon	$7.7	$8.8	$9.1
Beaver Slough Siphon	$13.6	$16.2	$16.9
Lost Slough Siphon	$7.8	$9.4	$9.8
Snodgrass Slough Siphon	$8.5	$9.8	$10.2
SUBTOTAL	$522.4	$665.8	$789.7
Contigencies (20%)	$104.5	$133.2	$157.9
ESTIMATED CONSTRUCTION COST	$626.9	$799.0	$947.6
Engineering, Legal, and Project Administration (35%)	$219.4	$279.7	$331.7
ESTIMATED CAPITAL COST	$846.3	$1,078.7	$1,279.3
Capital Cost Range (minus 10% - plus 15%)	$762 - $973	$971 - $1,241	$1,151 - $1,471

D-008865

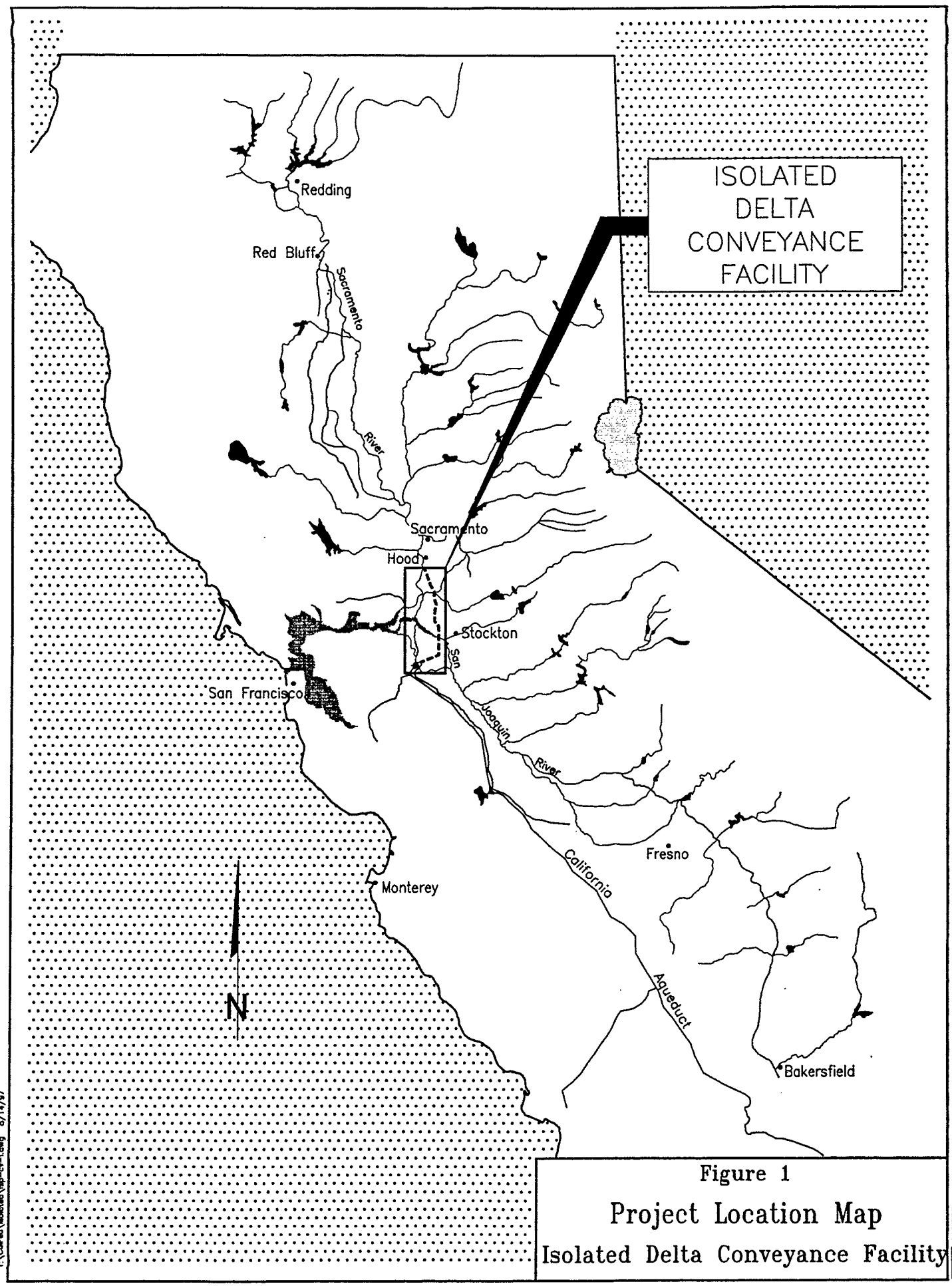

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Figure 1

Project Location Map

Isolated Delta Conveyance Facility

CALFED BAY-DELTA PROGRAM

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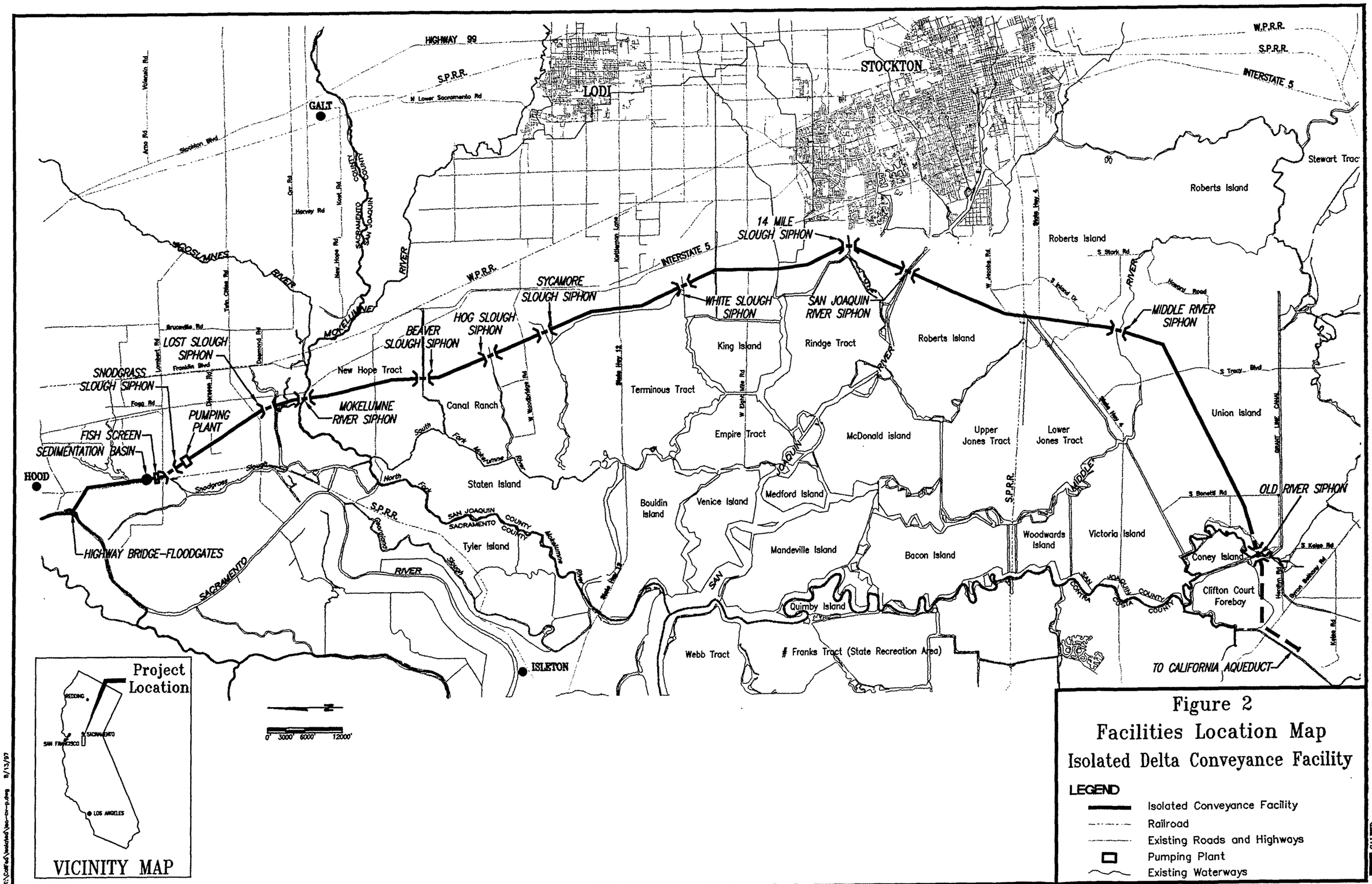

Figure 2
Facilities Location Map
Isolated Delta Conveyance Facility

LEGEND

- Isolated Conveyance Facility
- Railroad
- Existing Roads and Highways
- Pumping Plant
- Existing Waterways

CALFED BAY-DELTA PROGRAM

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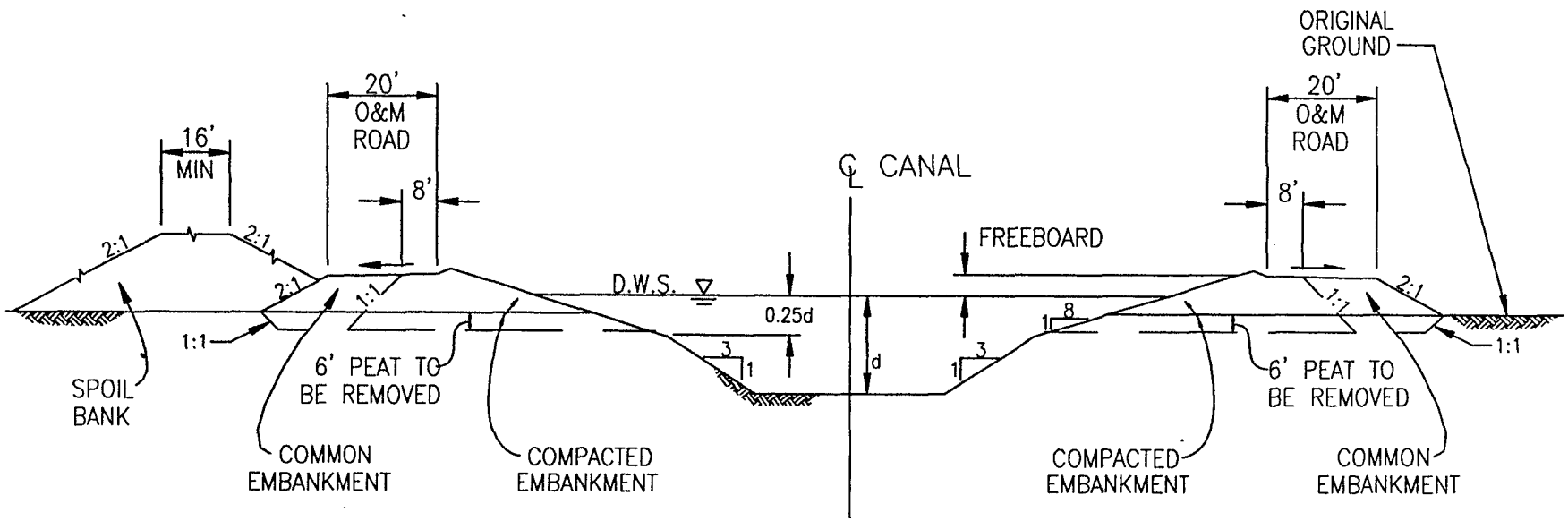

TYPICAL CANAL SECTION
NOT TO SCALE

Figure 3

Typical Canal Section Isolated Delta Conveyance Facility

D-008869

FACILITY DESCRIPTIONS AND UPDATED COST ESTIMATES FOR THE MULTIPLE INTAKES OPTION

Prepared by the CALFED Storage and Conveyance Refinement Team
October 1997

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INTRODUCTION

The *Facility Descriptions and Updated Cost Estimates for the Multiple Intakes Option* has been prepared as part of the Storage and Conveyance Component Refinement Task of the CALFED Bay-Delta Program (CALFED or Program). CALFED's mission is to develop a long-term comprehensive plan that will restore the ecological health and improve water management for beneficial uses of the San Francisco Bay/Sacramento-San Joaquin Delta (Bay-Delta) system.

This report summarizes the principal features, estimated costs, and environmental considerations of constructing a Multiple Intakes Option project which would consist of three separate and isolated diversion and conveyance facilities from western, northern, and eastern Sacramento-San Joaquin Delta (Delta) channels to Clifton Court Forebay. The Multiple Intakes Option would provide an alternative means of diverting water from the Delta for export through the State Water Project (SWP) and the Central Valley Project (CVP). The general location of this project is shown in Figure 1.

This evaluation and others being performed by CALFED are intended to provide facilities evaluations and updated costs estimates of representative storage and conveyance components. The objectives of the Multiple Intakes Option evaluation are to (1) provide an estimate of the capital cost of constructing this project within the range expected if the project were to be constructed today and (2) enable CALFED to compare this project against other projects that might be considered as part of a long-term CALFED solution strategy.

The Multiple Intakes Option is a new diversion and conveyance alternative being considered by CALFED and, therefore, limited existing information is available on this project. The estimated capital cost for constructing the Multiple Intakes Option was developed primarily by Bookman-Edmonston Engineering and was based on available information, previous experience, and engineering judgment. The previous studies used to aid the predevelopment of the present cost estimate include the 1993 Department of Water Resources (DWR) *Interim South Delta Program*

(ISDP) Cost Estimate, Proposed Clifton Court Forebay Northern Intake Structure and the 1995 DWR report titled *Isolated Transfer Facility Cost Estimate.*

A preliminary evaluation of the environmental considerations associated with this project has also been included in this report. Fish, wildlife, plant, and cultural resources that could be affected have been described and potential impacts have been identified. The information for the evaluation of environmental considerations was gathered from existing literature.

PROJECT BACKGROUND

Reclamation of Delta marshlands began in the 1850s, and by the 1930s, nearly all of the Delta had been reclaimed into intensely farmed islands. Ocean salinity intrusion to the interior of the Delta was observed as early as the 1840s and was recognized as a potential problem to water supplies. Since that time, there have been numerous studies of methods to control salinity intrusion and otherwise improve the management of the water resources in the Delta.

The Multiple Intakes Option is a relatively new water conveyance concept which would help improve the management of water resources in and through the Delta. Over the past several years, studies have been completed for similar concepts which would essentially move the water export location from Clifton Court Forebay to other locations within the Delta. However, a review of the DWR and the U.S. Bureau of Reclamation (Reclamation) libraries and publications revealed no previous investigations of the Multiple Intakes Option. DWR's 1993 investigation for the ISDP did identify several alternatives, which are now components of the Multiple Intakes Option, particularly the isolated intake channel from the San Joaquin River. Detailed below is a brief summarization of the major events that have led to the development of the Multiple Intakes Option concept.

In 1960, California voters approved the Burns-Porter Act to assist in the financing of the SWP. This Act authorized Delta facilities "... for water conservation, water supply in the Delta, transfer

of water across the Delta, flood and salinity control, and related functions." In the same year, DWR proposed the Delta Water Project to serve as the Delta water facility of the SWP. This plan, however, was met with stiff opposition from Delta water users, boaters, fish and wildlife agencies, and other Delta interests. In 1965, the Interagency Delta Commission (comprised of DWR, California Department of Fish and Game (CDFG), Reclamation, and the U. S. Army Corps of Engineers) recommended the "Peripheral Canal" as an acceptable plan for water transfers across the Delta. The Peripheral Canal would convey water from the Sacramento River at Hood to the SWP and CVP pumping plants in the south Delta while minimizing interference with Delta waterways and releasing freshwater to Delta channels to maintain water quality and mitigate impacts to fish.

While DWR and Reclamation accepted and supported the construction of the Peripheral Canal as a joint-use facility of the SWP and the CVP, the facility was never constructed, partly for the following reasons:

- Although Reclamation and the Department of the Interior (Interior) embraced the concept of the facility in 1969, federal funding was never forthcoming.

- There was continuing fear of and controversy over the cost of the facility and of potential harm to the Bay-Delta from improper operation: some water users believed that water could be obtained at a lower cost; other Delta interests feared that guarantees for Delta protection could be changed or ignored during times of shortage.

DWR began reassessing the Peripheral Canal in 1975, resulting in Bulletin 76 (DWR, July 1978), which identified and considered numerous alternative water transfer facilities. In 1980, the State Legislature passed and Governor Brown signed Senate Bill (SB) 200. This bill authorized the Peripheral Canal and provided specific guarantees to protect the Delta and to meet the water needs of the SWP through the year 2000. SB 200 was subjected to a statewide referendum vote in June 1982, which California voters did not approve.

As part of a continuing effort to better manage the Delta, DWR and Reclamation have conducted several studies over the past decade. In July 1996, DWR and Reclamation jointly released the *Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS) — Interim South Delta Program (ISDP).* The ISDP had two objectives: (1) to improve water levels and circulation in south Delta channels for local agricultural diversions and (2) to improve south Delta hydraulic conditions to increase diversions into Clifton Court Forebay to maximize the frequency of full pumping capacity at Banks Pumping Plant. Various elements of the ISDP have been incorporated into the following evaluation of a Multiple Intakes Option.

A wide range of facility configurations have been investigated by agencies and stakeholders participating in the CALFED process. The Multiple Intakes Option was suggested as an approach, which could provide a great deal of flexibility to CVP and SWP export operations. If operated in response to real-time monitoring, the location of export withdrawals from the Delta could be managed to minimize the impacts to the Delta's fishery resources while improving the reliability of export supplies and meeting water quality objectives.

The Multiple Intakes Option concept was identified in a March 1997 CALFED technical studies report titled *Status Reports on Technical Studies for the Storage and Conveyance Refinement Process.* This Delta conveyance concept has recently gained recognition through the CALFED process as a potential part of a long-term comprehensive plan that could restore the ecological health of and improve water management of the Bay-Delta. This evaluation builds on that concept and will provide CALFED with a cost estimate and a written description of the Multiple Intakes Option project that will enable it to be compared to other projects for consideration as part of a long-term CALFED solution strategy.

FACILITIES DESCRIPTION

This section provides an overview of the major features included in the Multiple Intakes Option. The preliminary layout of the Multiple Intakes Option is based on original work developed by

CALFED staff and Bookman-Edmonston Engineering. The Multiple Intakes Option includes three separate intake facilities, each with a capacity of 15,000 cubic feet per second (cfs), as well as improvements to CVP and SWP south Delta export facilities. This intake and conveyance system would provide water operations flexibility by allowing diversions to take place at one of three separate intake locations in the Delta to limit environmental impacts and improve water quality of export supplies. The Multiple Intakes Option described in this evaluation may be combined with other Delta actions to achieve the objectives of the CALFED Program.

PROJECT LOCATION

The general project location of the Multiple Intakes Option is shown in Figure 1. The Multiple Intakes Option would be located in the Delta in San Joaquin and Contra Costa Counties. The proposed facilities would include three new diversion structures and conveyance facilities. These facilities are designated as the Western Delta Isolated Intake (Western Intake), the Northern Delta Isolated Intake (Northern Intake), and the Eastern Delta Isolated Intake (Eastern Intake). Figure 2 provides a detailed location map of these three facilities and of the CVP and SWP improvements which make up the Multiple Intakes Option. This map is complete with locations of all the relevant facilities, including gated intake structures, pumping plants, fish screening facilities, isolated conveyance channels, setback levee channels, and improvements for the CVP and SWP export facilities.

The Western Intake would begin at the northeast corner of Palm Tract on Rock Slough. Setback levees would create an isolated channel that would convey water south across Palm, Orwood, and Byron Tracts and Victoria Island a distance of approximately 8 miles to Clifton Court Forebay.

The Northern Intake would begin on the north side of Lower Roberts Island along the San Joaquin River and would divert water into an isolated conveyance channel which would cross Lower and Middle Roberts, Union and Coney Islands for approximately 14 miles before entering Clifton Court Forebay.

The Eastern Intake would begin at Upper Roberts Island and divert San Joaquin River water into an isolated channel that would continue west across Upper Roberts Island and Union Island for approximately 14 miles before reaching Clifton Court Forebay.

PROJECT DESCRIPTION

The Multiple Intakes Option concept consists of three separate intake and conveyance facilities hydraulically isolated from existing Delta channels to convey Delta water to Clifton Court Forebay. As proposed, the Multiple Intakes Option would help alleviate fish impacts and water quality concerns for Delta exports by providing three alternative diversion points for providing water to Clifton Court Forebay. As mentioned earlier, the Multiple Intakes Option would also include CVP and SWP improvements to maximize the flexibility of the Delta export system.

PRINCIPAL FACILITIES

This section provides an overview of the major facilities associated with the Multiple Intakes Option. This includes the three intake and isolated conveyance facilities as well as proposed CVP and SWP improvements. The principal facilities for each of the three intakes include a gated intake structure with fish screens, a low-lift pumping plant, an unlined isolated conveyance channel, river siphon crossings, and associated works. Table 1 provides a summary of the physical characteristics of each of the major features associated with the Multiple Intakes Option.

Western Intake

The Western Intake would include an 8-mile-long, isolated setback levee conveyance channel, an intake structure with fish screens, four under-river siphon crossings, and associated works to convey 15,000 cfs from the northeast corner of Palm Tract at the confluence of Old River and Rock Slough to Clifton Court Forebay. The Western Intake would require construction of new facilities on Palm, Orwood, Byron Tracts and Victoria Island (see Figure 2). The Western Intake

conveyance alignment would parallel Old River and would be approximately 1,000 feet wide. The setback levee conveyance channel would be isolated from the existing Old River channel utilizing a new setback levee and existing levees. The new setback levee would be located about 500 feet to the west of the existing Old River channel levees. Figure 4 shows a typical cross-section of the Western Intake setback levee channel.

Palm Tract

The intake structure of the Western Intake would consist of an intake structure with five 20' x 50' radial gates with a total capacity of 15,000 cfs located on the northeast corner of Palm Tract at the confluence of Old River and Rock Slough. The approximate location of the intake is shown in Figure 2. A concrete section would be constructed to provide a transition between the intake facility and the unlined channel. Water would enter the intake facility and flow by gravity through a fish screening facility. The fish screening facility would incorporate best available technology for the design and operation of the facility.

After passing through the fish screens, water would flow by gravity through the isolated setback levee channel, which would be created by constructing a new setback levee roughly 500 feet west of Old River. The existing levee protecting Palm Tract would separate Old River from the isolated channel and would become the east bank of the isolated channel. Depending on the meanders in Old River adjacent to Palm Tract, the width of the isolated channel would be approximately 500 feet. A siphon at the southern end of Palm Tract would cross beneath an unnamed slough, the Mokelumne Aqueduct, and railroad tracks to Orwood Tract. The siphon structure would consist of six 30' x 30' concrete boxes with a capacity to convey 15,000 cfs to Orwood Tract.

Orwood Tract

Water siphoned from Palm Tract would enter the setback levee channel and continue south for about 9,000 feet before being siphoned beneath Indian Slough to Byron Tract. The setback levee channel would be created through the construction of a setback levee roughly 500 feet west of and parallel to Old River. The west side of the Old River levee would then become the east bank of the isolated conveyance channel. A siphon at the southern end of Orwood Tract would convey water to Byron Tract beneath Indian Slough. The siphon structure would consist of six 30' x 30' concrete boxes with a capacity to convey 15,000 cfs to Byron Tract.

Byron Tract

Water entering Byron Tract from Orwood Track would enter the setback levee channel and continue south on Byron Tract to Highway 4. The channel would be created by constructing a setback levee approximately 500 feet to the west and parallel to Old River. The west side of the Old River levee would then become the east bank of the isolated conveyance channel. A siphon located at Highway 4 would convey water beneath Old River to the southern half of Victoria Island. This siphon structure would consist of six 30' x 30' concrete boxes with the capacity to convey 15,000 cfs to Victoria Island, which lies east of Old River and just north of Clifton Court Forebay.

The route of the Western Intake conveyance channel was designed to avoid impacts to the Old River Pumping Plant for the Los Vaqueros Reservoir project being constructed by Contra Costa Water District. The Old River Pumping Plant is located just south of Highway 4. Therefore, the isolated conveyance channel was routed beneath Old River, north of Highway 4, to Victoria Island.

Victoria Island

Water entering Victoria Island from Byron Tract would enter the setback levee channel and would continue south for about 13,500 feet. The isolated channel would be created by the construction of a setback levee parallel to Old River, set back about 500 feet to the east. The east side of the Old River levee would become the west bank of the isolated conveyance channel. At the southern end of Victoria Island a siphon would convey water beneath Old River to Clifton Court Forebay. This siphon would consist of six 30' x 30' concrete boxes with the capacity to convey 15,000 cfs to Clifton Court Forebay. The siphon structure would include radial gates, five 20' x 50' gates, to control the flow entering Clifton Court Forebay.

Northern Intake

The Northern Intake would include a 14-mile-long unlined isolated conveyance channel with a capacity of 15,000 cfs. The conveyance channel would include an intake structure with fish screens, a low-lift pumping plant, three river siphon crossings, and associated works. The Northern Intake would require construction of new facilities on Lower Roberts, Union, and Coney Islands (see Figure 2). Water would be diverted from the San Joaquin River through a low-lift pumping plant to Lower Roberts Island and conveyed southwest through Union Island and Coney Island to Clifton Court Forebay. A concrete transition would be constructed between the intake structure and the pumping plant. The Northern Intake would have a 2,000-foot-wide alignment for its entire length. This alignment would require construction of nine bridges and crossings.

The main conveyance channel would consist of an unlined, open channel. As shown in Figure 3, the typical cross-section of the isolated facility would consist of a trapezoidal section with side slopes of 3:1 and back slopes of 2:1. Special treatment would be required in areas where the peat soil may pose a threat to stability. Located on either side of the channel would be a 20-foot-wide operations and maintenance (O&M) road. The channel would have a top width of 350 feet, a

bottom width of 140 feet, and a depth of 28 feet from the normal operating water surface elevation. The capacity of channel and all the related facilities would be 15,000 cfs.

Lower Roberts Island

This first reach of the Northern Intake would consist of a gated intake located on the north side of Lower Roberts Island on the San Joaquin River. The approximate location of the intake is shown in Figure 2. The intake facility would consist of five 20' x 50' radial gates with a capacity of 15,000 cfs. A fish screening facility, with a matching capacity of 15,000 cfs, would also be located at the intake structure. The fish screening facility would incorporate best available technology for the design and operation of the facility. A low-lift pumping plant would be required to provide sufficient hydraulic head to gravity flow water to Clifton Court Forebay and to optimize the hydraulics of the fish screening facility. The 15,000 cfs pumping plant would consist of 11 pumping units, including one standby unit, and would have a total horsepower of 25,080 and a total dynamic head of 10 feet.

From the intake and pumping plant, water would enter the unlined open channel and continue south for about 5 miles to Highway 4. At this location the channel would continue southwest, parallel to Highway 4, to Middle River where it would be siphoned beneath Middle River to Union Island. This siphon would consist of six 30' x 30' concrete boxes with the capacity to convey 15,000 cfs to Union Island.

Union Island

Water entering Union Island from Lower Roberts Island would enter the unlined, open channel and would continue southwest for about 20,000 feet adjacent to the south bank of Victoria Canal/North Canal. At the west end of Union Island, the channel would then be siphoned beneath Old River to Coney Island. This siphon would consist of six 30' x 30' concrete boxes with the capacity to convey 15,000 cfs to Coney Island.

Coney Island

Water entering Coney Island from Union Island would enter the unlined open channel and would continue southwest for about 3,500 feet before being siphoned beneath the West Canal into Clifton Court Forebay. This siphon would consist of six 30' x 30' concrete boxes to convey 15,000 cfs 400 feet from Coney Island to Clifton Court Forebay. The siphon structure would include radial gates, five 20' x 50' gates, to regulate the flows entering Clifton Court Forebay.

Eastern Intake

The Eastern Intake would consist of a 14-mile unlined isolated conveyance channel with a capacity of 15,000 cfs. The isolated conveyance channel would include an intake structure with fish screens, a low-lift pumping plant, two under-river siphon crossings, and associated works. The Eastern Intake would require construction of new facilities on Upper Roberts and Union Islands (see Figure 2). Water would be diverted from the San Joaquin River through a low-lift pumping plant to Upper Roberts Island and conveyed west through Union Island to Clifton Court Forebay. A concrete transition would be constructed between the intake structure and the pumping plant. The Eastern Intake would have a 2,000-foot-wide alignment for its entire length.

As shown in Figure 5, the typical cross-section of the isolated conveyance facility would consist of a trapezoidal section with side slopes of 3:1 and back slopes of 2:1. Special treatment would be required in areas where the peat soil may pose a threat to stability. Located on either side of the conveyance channel would be a 20-foot-wide O&M road. The 15,000 cfs channel would generally have a top width of 350 feet, a bottom width of 140 feet, and a depth of 28 feet from the normal operating water surface elevation.

Upper Roberts Island

The intake for the Eastern Intake would consist of a gated intake structure with five 20' x 50' radial gates with a capacity of 15,000 cfs located on the east side of the Upper Roberts Island on the San Joaquin River. The approximate location of the intake is shown in Figure 2. A fish screening facility, with a matching capacity of 15,000 cfs, would be located at the intake structure. The screening facility would include best available technology in the design and operation of the facility. The Eastern Intake would include a low-lift pumping plant to provide sufficient hydraulic head to gravity flow water to Clifton Court Forebay and to control the hydraulics of the fish screening facility. The 15,000 cfs pumping plant would consist of 11, 1,500 cfs units, including one standby, and would have a total horsepower of 25,080 and a total dynamic head of 10 feet.

From the intake and pumping plant, water would enter the unlined channel and continue west for about 4 miles to Middle River. At this location the channel would siphon beneath Middle River to Union Island. This siphon would consist of six 30' x 30' concrete boxes with the capacity to convey 15,000 cfs to Union Island.

Union Island

Water entering Union Island from Upper Roberts Island would continue southwest through an unlined channel towards the Grant Line Canal and Fabian and Bell Canals. The alignment would then turn west and parallels these canals for about 9 miles to Old River. At this location a siphon would convey water beneath Old River to Byron Tract where the open channel continues northwest for one-third of a mile before reaching Clifton Court Forebay. This siphon would consist of six 30' x 30' concrete boxes with the capacity to convey 15,000 cfs to Clifton Court Forebay. The siphon structure would include radial gates, five 20' x 50' gates, to regulate the flow entering Clifton Court Forebay.

CVP-SWP Improvements

Improvements to CVP and SWP south Delta facilities would include an interconnection between Clifton Court Forebay and the lower portion of the Delta-Mendota Canal and improved fish screens for the Tracy Pumping Plant. The physical characteristics of the improvements at Clifton Court Forebay and the Delta-Mendota Canal are summarized in Table 1 and shown in Figure 2. The interconnection would allow water stored in the forebay to be diverted to the CVP's Tracy Pumping Plant for delivery to the Delta-Mendota Canal. The interconnection would be gated to maximize the operational flexibility of the system. An additional gate would be constructed on the Delta-Mendota Canal just downstream of the interconnection. The gate on the Delta-Mendota Canal would enable flows to be released into the Delta-Mendota Canal from Clifton Court Forebay during low tide conditions. The existing fish screens associated with the Tracy Pumping Plant would be upgraded with the best available technology.

COST ESTIMATE

The Multiple Intakes Option is a new project that has not been previously studied; thus, there is no specific previous information describing or estimating the cost of this project. There are, however, some studies with similar components from which comparative costs can be derived. The cost estimate for the Multiple Intakes Option was developed primarily by Bookman-Edmonston Engineering and was based on available information, previous experience, and engineering judgment. These previous studies include the *1993 DWR, ISDP Cost Estimate: Proposed Clifton Court Forebay Northern Intake Structure* and the 1995 DWR report *Isolated Transfer Facility Cost Estimate.*

COST ESTIMATE METHODOLOGY

General

The cost estimates for the Multiple Intakes Option were determined by applying current unit costs to the quantities developed by Bookman-Edmonston Engineering. Some of the costs used to update this cost estimate were determined by escalating the unit cost to October 1996 dollars using Reclamation's Construction Cost Trends (CCT) indices. Additional unit costs were developed by Bookman-Edmonston Engineering based on engineering and construction experience. The cost estimate does not include the cost of environmental documentation, environmental mitigation, operation and maintenance, power, and interest during construction.

Table 2 provides a detailed breakdown of the estimated costs of the Multiple Intakes Option. Cost items identified in previous cost estimates have been provided, along with the unit cost of the items or an indication that the estimated cost has been developed through a lump sum approach. The tables also include the Reclamation CCT index for the month and year in which the estimated cost was developed and for October 1996. These Reclamation cost indices are used to factor the previous cost estimate to October 1996 dollars. In some instances, only a unit cost has been provided, with no cost indices. In these cases, the unit cost has been taken from other sources. The far right-hand column of Table 2 provides the cost reference for each cost item.

Pumping Plants

The cost estimate for the Pumping Plants associated with the Multiple Intakes Option has been based on the cost and quantities from the September 1995 DWR report titled *Isolated Transfer Facility Cost Estimate*. These costs were originally priced in July 1995 dollars and have been updated to October 1996 dollars using the CCT indices described above.

Right-of-Way Costs

Right-of-way costs of $3,000 per acre were used based on land use costs developed by Reclamation's, Land Resources Branch (Personal Communication, February 1997). The right-of-way necessary for the development of the Multiple Intakes Option would require 8,110 acres. In addition, the Western Intake component would require relocation of irrigation diversions and drainage pumps on Palm, Orwood, Byron Tracts and Victoria Island that would involve an additional 8,400 acres at an estimated cost of $1,000 per acre. Similarly, the Eastern Intake component would involve the relocation of irrigation diversions and drainage pumps involving 8,350 acres on Union Island at an estimated cost of $1,000 per acre.

Contingencies and Other Costs

All contingencies and engineering, construction management, and administrative factors were determined by engineering judgement based on similar level of cost estimation. Contingencies were chosen to be 20 percent; engineering, construction management, and administration were chosen to be 35 percent. A cost range was developed for the project by subtracting 10 percent from the estimated capital cost for the low-end cost and adding 25 percent to the estimated capital cost for the high-end cost.

PRELIMINARY COST FINDINGS

Costs of the Multiple Intakes Option and supporting facilities have been developed to an October 1996 basis as described above. Table 3 summarizes estimated costs of the major items associated with the Multiple Intakes Option. The total estimated capital cost of the Multiple Intakes Option is estimated to be about $2,492 million with a resulting calculated cost range from $2,243 to $3,115 million.

ENVIRONMENTAL CONSIDERATIONS

[NOTE: The environmental considerations section needs to be reevaluated by DWR to ensure consistency with the information presented in the previous section.]

This portion of the report provides a summary of environmental considerations related to the Multiple Intakes Option. Fish, wildlife, plant, and cultural resources that could be affected by the proposal are described and the extent of the impacts is identified. The information presented in this section was gathered from existing literature, with limited original research. No field work was conducted for this analysis.

WILDLIFE

The Multiple Intakes Option would impact approximately 6,000 acres of agricultural lands and terrestrial wildlife habitat. Almost all of these lands are presently in agricultural use.

Fish, Amphibians, Reptiles, and Invertebrates

The Multiple Intakes Option could affect several waterways that support both anadromous and resident game and non-game fish. Depending on outflow regimes and water year hydrology, the Delta supports several types of habitats including estuary, freshwater, and marine water environments. In all, the Delta's various water environments support about 90 species of fish. Fish dependant on the Delta as a migration corridor, nursery, or permanent residents include striped bass, chinook salmon, steelhead trout, American shad, sturgeon, catfish, largemouth bass, winter-run chinook salmon, Delta smelt, Sacramento splittail, and numerous other marine and freshwater species.

California tiger salamander is found in the Delta. This species requires quiet, still water for breeding. The major waterways in the area are deep, swift, and subject to frequent inundation to

provide suitable habitat for this species. Many of the irrigation ditches in the area are kept clear of aquatic vegetation, while the surrounding lands are intensively cultivated, further reducing suitable habitat for tiger salamanders.

General Wildlife

Lands within the areas of the proposed project support a highly diverse wildlife. Important groups of wildlife dependant on the Delta are waterfowl and other migratory birds, game birds such as pheasant and quail, furbearers, and numerous nongame birds and mammals. The Delta is particularly important to waterfowl migrating via the Pacific Flyway. The principal attraction for waterfowl is winter flooded agricultural fields, mainly cereal crops, which provide food and extensive seasonal wetlands. Small mammals find suitable habitat in the Delta and upland areas. Vegetated levees, remanent of riparian forest, and undeveloped islands provide habitat for numerous small mammals. Small mammal species include muskrat, mink, river otter, beaver, raccoon, gray fox, and skunks. A variety of non-game wildlife such as songbirds, hawks, owl, reptiles, and amphibians can also be found in the area.

Sensitive and Listed Fish and Wildlife Species

According to the CDFG's National Diversity Database, listed wildlife species that have been recorded in or around the area that would be directly affected by the proposed project include California red-legged frog (federal threatened), Swainson's hawk (State threatened), California black rail (State threatened), and San Joaquin kit fox (federal endangered, State threatened).

Other unrecorded listed species that could potentially occur in the area include American peregrine falcon (federal endangered), Aleutian Canada goose (federal endangered), bald eagle (federal/State endangered), winter-run chinook salmon (federal endangered), Delta smelt (federal threatened), and Delta green ground beetle (federal threatened).

Wildlife species that are either candidates for State or federal listing or considered species of special concern by the CDFG known to occur in the area affected by the proposed project include California tiger salamander (federal candidate, species of special concern), white-tailed kite, burrowing owl (species of special concern), San Joaquin pocket mouse (species of special concern), and western pond turtle.

Limited sporadic use of the project area may also occur for wintering greater sandhill cranes. This species (State-listed threatened) is a common winter migrant to the eastern Sacramento Valley. While the crane does not nest in the project area, it could use the open grasslands for foraging.

Bald eagle, peregrine falcon, yellow-billed cuckoo, and Aleutian Canada goose have been observed in the Delta, but none are confined exclusively to the area.

VEGETATION

The Multiple Intakes Option would affect approximately 6,000 acres of agricultural and disturbed lands. Most of these lands are presently used for agriculture.

Sensitive and Listed Plant Species

A federal candidate (State endangered) plant, Mason's lilaeopsis, has been known to occur in or around the area of the proposed project. Delta button-celery (federal candidate, State endangered) could also be affected by this alternative.

Candidate plant species for federal listing that may occur in the area include Suisun marsh aster, caper-fruited tropidocarpum, San Joaquin saltbush, ferris's milk vetch, Delta tule pea, and recurved larkspur.

Additional plants listed by the California Native Plant Society as being rare, threatened or endangered in California and elsewhere, could also be affected by the proposed Multiple Intakes Option. These plants include big tarweed, Wright's trichocoronis, marsh skullcap, California hibiscus, heartscale, Delta mudwort, and bristly sedge.

Special Status Habitats that may be found along or near the area of the proposed alternative include: Valley Sink Scrub, Northern Claypan Vernal Pool (see Wetlands), Alkali Meadow, Coastal and Valley Freshwater Marsh (see Wetlands), and Great Valley Oak Riparian Forest.

Wetlands

From information gathered from the USFWS's National Wetland Inventory map, the proposed Multiple Intakes Option would have impacts at the three intake areas.

The western intake would impact approximately 9 miles of farmed wetlands, over 2 miles of scrub-shrub seasonal tidal wetlands, seven acres of scrub-shrub seasonally flooded wetlands (shallow marsh), and 29 acres scrub-shrub/emergent semipermanent saturated wetlands (deep marsh).

The northern intake would impact approximately 18 miles of farmed wetlands, over 2 miles of scrub-shrub seasonal tidal wetlands, ten acres of scrub-shrub seasonal tidal wetlands, 3 miles of aquatic bed intermittently exposed, 29 acres of scrub-shrub/emergent semipermanently saturated wetlands (deep marsh), 40 acres of emergent saturated semipermanent wetlands (deep marsh), 1 mile scrub-shrub seasonally flooded wetlands (shallow marsh), and 7 miles of scrub-shrub seasonally flooded wetlands (shallow marsh). This intake would cross Middle River and the Mokelumne Aqueduct.

The eastern intake would impact approximately 6 miles of farmed wetlands, 6 miles of forested/scrub-shrub temporary tidal wetlands, 1 mile of scrub-shrub seasonal tidal wetlands, and

4 miles of scrub-shrub/emergent seasonal tidal wetlands. This intake would cross Middle River.

Three special-status wetland habitats, Northern Claypan Vernal Pool, Alkali Meadow, and Coastal and Valley Freshwater Marsh, could be affected by the proposed Multiple Intakes Option.

CULTURAL RESOURCES

Archaeological sites throughout the Delta province may be over-represented. Historic activities connected with channel dredging, levee construction and maintenance, residential development, and agriculture have obscured, buried, and destroyed many sites since the first half of the 20th century, when most were first found. Additionally, some may now also be buried under alluvium.

Prehistoric settlements in the delta were situated on low rises above flood level, mounds on low knolls, natural levees, and on higher ground along the banks of streams and rivers. Reclamation and farming activities have leveled most of these areas of higher relief. Field inspection will be necessary to verify the existence and condition of these sites for a more accurate assessment.

Historic period sites and features in the Delta province are generally under-represented. The surveys responsible for identifying most of the archaeological sites were performed by the University of California, Berkeley, during the time when there was little concern for historic period resources. Almost all of them have been recorded since the 1970s.

In addition to farmsteads, ranches, and townsites, there are resources noted on the quadrangle maps that would require evaluation. These resources include levees, pumphouses, pumping stations, windmills, railroad grades, roads and bridges, pilings, piers, landings, and gas wells.

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U.S. Geological Survey Topographic Maps.

Table 1
SUMMARY OF PHYSICAL CHARACTERISTICS
MULTIPLE INTAKES OPTION

	Western Intakes	Northern Intakes	Eastern Intakes
Intake Facilities			
Radial Gates (quantity)	5	5	5
Radial Gates (size)	20'x50'	20'x50'	20'x50'
Fish Screening Facilities			
Capacity (cfs)	15,000	15,000	15,000
Pumping Plants			
Capacity (cfs)	--	5,000	5,000
11 Pumps (1 standby) (cfs)	--	1,500	1,500
Total Dynamic Head (feet)\	--	10	10
Total Plant Horsepower (HP)	--	25,080	25,080
Earth Channels			
Length (miles)	8	14	14
Top Width (feet)	500	350	350
Bottom Width (feet)	350-380	140	140
Depth (feet)	15	28	28
Side Slopes	3:1	3:1	3:1
Embankment (cubic yards)	N/A	10,712,000	12,106,000
Compacted Embankment Volume (cubic yards)	N/A	14,871,000	2,648,000
Common Embankment (cubic yards)	N/A	6,021,000	1,334,000
Right-of-Way (acres)	1,358	3,400	3,352
Setback Levees (length - feet)	45,000	--	--
Reenforced Levees (length - feet)	56,800	--	--
Siphons			
Typical Number and Size	six 30'x30'	six 30'x30'	six 30'x30'
Western Intake			
Mokelumne River Aqueduct and RR Siphon (length in feet)	1,300	--	--
Indian Slough Siphon (length in feet)	700	--	--
Old River and Highway 4 Bridge Siphon (length in feet)	600	--	--
Siphon Under Old River into Clifton Court Forebay (length in feet)	1,300	--	--
Northern Intake			
Old River Siphon (length in feet)	--	600	--
Middle River Siphon (length in feet)	--	700	--
West Canal Siphon (length in feet)	--	400	--
Eastern Intake			
Middle River Siphon (length in feet)	--	--	200
Old River Siphon (length in feet)	--	--	600
CVP-SWP Improvements			
New Interconnection Between Clifton Court Forebay and Delta-Mendota Canal			
Capacity (cfs)			4,500
Number of Radial Gates			2
New Radial Gate Control Structure on Delta-Mendota Canal			
Capacity (cfs)			4,500
Number of Radial Gates			2
Upgraded Fish Screens at the Tracy Pumping Plant			
Screen type			Folded-V
Capacity (cfs)			4,500

Table 2
ESTIMATED CAPITAL COSTS
MULITPLE INTAKES OPTION

DESCRIPTION	QUANTITY	UNIT[a]	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
WESTERN 15,000 CFS ISOLATED SOUTH DELTA INTAKE					
I. INTAKE FACILITIES					
20'x50' Radial Gates	5	EA	$510,000	$2,550,000	1
Concrete	8,000	CY	$600.00	$4,800,000	1
Dewatering	JOB	LS	$150,000.00	$150,000	1
Electrical Works	JOB	LS	$500,000.00	$500,000	1
Fish Screens	15,000	CFS	$10,000.00	$150,000,000	1
Miscellaneous Cost @10%				$800,000	
SUBTOTAL INTAKE FACILITIES				$158,800,000	
II. STRENGTHENING OF EXISTING LEVEES					
Strengthening of West Levee of Old River North of Hwy. 4					
and East Levee of Old River South of Hwy. 4 with Riprap,					
Bedding, and Geotextile	56,800	LF	$319.32	$18,137,376	1
SUBTOTAL STRENGTHENING OF EXISTING LEVEES				$18,137,376	
III. CONSTRUCT NEW SETBACK LEVEES					
Construct New Setback Levees for Conveyance Channel,					
with Riprap, Bedding, and Geotextile on Channel Side of Slope.	45,000	LF	$1,433.30	$64,498,500	1
Fencing	45,000	LF	$5.00	$225,000	1
SUBTOTAL CONSTRUCT NEW SETBACK CHANNEL				64,723,500	
IV. MOKELUMNE RIVER AQUEDUCT AND R.R. SIPHON					
6-30'x30' Concrete Box	161,200	CY	$600.00	$96,720,000	1
Riprap	25,000	CY	$50.00	$1,250,000	1
Dewatering	JOB	LS	$1,500,000.00	$1,500,000	1
Railroad Detour	JOB	LS	$500,000.00	$500,000	1
Miscellaneous @ 5%				$4,998,500	
SUBTOTAL MOKELUMNE RIVER AQUEDUCT AND R.R. SIPHON				$104,968,500	

Table 2
ESTIMATED CAPITAL COSTS
MULITPLE INTAKES OPTION

	DESCRIPTION	QUANTITY	UNIT[a]	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
V.	INDIAN SLOUGH SIPHON					
	6- 30'x30' Concrete Box	86,800	CY	$600.00	$52,080,000	1
	Riprap	25,000	CY	$50.00	$1,250,000	1
	Dewatering	JOB	LS	$200,000.00	$200,000	
	Miscellaneous @ 5%				$2,676,500	
	SUBTOTAL INDIAN SLOUGH SIPHON				$56,206,500	
VI.	OLD RIVER AND HWY. 4 BRIDGE SIPHON					
	6- 30'x30' Concrete Box	74,400	CY	$600	$44,640,000	1
	Riprap	25,000	CY	$50.00	$1,250,000	1
	Dewatering	JOB	LS	$500,000	$500,000	1
	Hwy. 4 Bridge	84,000	SF	$100	$8,400,000	1
	Miscellaneous @ 5%				$2,739,500	
	SUBTOTAL OLD RIVER AND HWY. 4 BRIDGE SIPHON				$57,529,500	
VII.	OLD RIVER SIPHON INTO CLIFTON COURT FOREBAY					
	6- 30'x30' Concrete Box	161,200	CY	$600	$96,720,000	1
	20'x50' Radial Gates	5	EA	$510,000	$2,550,000	1
	Transition Concrete (Forebay)	4,000	CY	$600	$2,400,000	1
	Riprap	25,000	CY	$50.00	$1,250,000	1
	Dewatering and Coffer Dam	JOB	LS	$1,000,000	$1,000,000	1
	Miscellaneous @ 5%				$5,196,000	
	SUBTOTAL OF OLD RIVER SIPHON				$109,116,000	
VIII.	RELOCATION OF IRRIGATION DIVERSIONS AND DRAINAGE PUMPS					
	Palm Track	2,000	AC	$1,000	$2,000,000	1
	Orwood Track	2,000	AC	$1,000	$2,000,000	1
	Byron Track	2,000	AC	$1,000	$2,000,000	1
	Victoria Island	2,400	AC	$1,000	$2,400,000	1
	Miscellaneous @ 10%				$840,000	
	SUBTOTAL RELOCATION FO IRRIGATION DIVERSIONS					
	AND DRAINAGE PUMPS				$9,240,000	
IX.	LAND COST					
	Palm Track	505	AC	$3,000	$1,515,000	1

Table 2
ESTIMATED CAPITAL COSTS
MULITPLE INTAKES OPTION

DESCRIPTION	QUANTITY	UNIT[a]	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Orwood Track	264	AC	$3,000	$792,000	1
Byron Track	280	AC	$3,000	$840,000	1
Victoria Island	309	AC	$3,000	$927,000	1
SUBTOTAL RAILROAD BRIDGE				$4,074,000	
SUBTOTAL WESTERN INTAKE				**$582,795,376**	
NORTHERN 15,000 CFS ISOLATED SOUTH DELTA INTAKE					
I. INTAKE FACILITIES					
20'x50' Radial Gates	5	EA	$510,000	$2,550,000	1
Concrete	8,000	CY	$600.00	$4,800,000	1
Dewatering	JOB	LS	$150,000.00	$150,000	1
Electrical Works	JOB	LS	$500,000.00	$500,000	1
Fish Screens	15,000	CFS	$10,000.00	$150,000,000	1
Miscellaneous Cost @10%				$800,000	
SUBTOTAL INTAKE FACILITIES				$158,800,000	
II. PUMPING PLANT					
Q= 15,000 cfs, TDH = 10', 11 ea. 2,280 HP unit (1 Stand-by)					
Pumps and Prime movers	JOB	LS	$35,864,000.00	$35,864,000	2
Structures and Improvements	JOB	LS	$19,544,000.00	$19,544,000	2
Electrical Equipment	JOB	LS	$3,698,000.00	$3,698,000	2
SUBTOTAL PUMPING PLANT				$59,106,000	
III. EARTH CANAL					
Embankment	10,712,000	CY	$2.00	$21,424,000	1
Compacted Embankment	14,871,000	CY	$0.80	$11,896,800	1
Common Embankment	6,021,000	CY	$0.50	$3,010,500	1
Borrow	17,616,000	CY	$5.00	$88,080,000	1
Fencing	148,000	LF	$5.00	$740,000	1
SUBTOTAL EARTH CANAL				$125,151,300	
IV. MIDDLE RIVER SIPHON					
6-30'x30' Concrete Box Including Rebar and Earthworks	86,800	CY	$600.00	$52,080,000	1
Transitions Concrete	7,000	CY	$600.00	$4,200,000	1

Table 2
ESTIMATED CAPITAL COSTS
MULITPLE INTAKES OPTION

	DESCRIPTION	QUANTITY	UNIT[a]	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
	Riprap	20,000	CY	$50.00	$1,000,000	1
	Dewatering	JOB	LS	$1,200,000.00	$1,200,000	1
	Miscellaneous @ 5%				$2,924,000	
	SUBTOTAL MIDDLE RIVER SIPHON				$61,404,000	
V.	**OLD RIVER SIPHON**					
	6- 30'x30' Concrete Box Including Rebar and Earthworks	74,400	CY	$600.00	$44,640,000	1
	Transitions Concrete	7,000	CY	$600.00	$4,200,000	1
	Riprap	20,000	CY	$50.00	$1,000,000	1
	Dewatering	JOB	LS	$1,200,000.00	$1,200,000	1
	Miscellaneous @ 5%				$2,552,000	
	SUBTOTAL OLD RIVER SIPHON				$53,592,000	
VI.	**WEST CANAL SIPHON**					
	6-30'x30' Concrete Box Including Rebar and Earthworks	49,600	CY	$600	$29,760,000	1
	20'x50' Radial Gates	5	EA	$510,000	$2,550,000	1
	Transitions Concrete	7,000	CY	$600.00	$4,200,000	1
	Riprap	20,000	CY	$50.00	$1,000,000	1
	Dewatering	JOB	LS	$1,200,000.00	$1,200,000	1
	Miscellaneous @ 5%				$1,935,500	
	SUBTOTAL WEST CANAL SIPHON				$40,645,500	
VII.	**COUNTY ROAD BRIDGES**					
	One Bridge	16,800	SF	$100.00	$1,680,000	1
	SUBTOTAL COUNTY ROAD BRIDGES				$1,680,000	
VIII.	**FARM AND PRIVATE ROAD BRIDGES**					
	8 Bridges @ 12,000 sq. ft.	96,000	SF	$100.00	$9,600,000	1
	SUBTOTAL FARM AND PRIVATE ROAD BRIDGES				$9,600,000	
IX.	**RAILROAD BRIDGE**					
	A.T. & S.F. R.R. Bridge	JOB	LS	$2,450,000.00	$2,450,000	2
	SUBTOTAL RAILROAD BRIDGE				$2,450,000	
X.	**LAND COST**	3,400	AC	$3,000.00	$10,200,000	1

Table 2
ESTIMATED CAPITAL COSTS
MULITPLE INTAKES OPTION

DESCRIPTION	QUANTITY	UNIT[a]	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
SUBTOTAL NORTHERN INTAKE				$522,628,800	
EASTERN 15,000 CFS ISOLATED SOUTH DELTA INTAKE					
I. INTAKE FACILITIES					
20'x50' Radial Gates	5	EACH	$510,000	$2,550,000	1
Concrete	8,000	CY	$600.00	$4,800,000	1
Dewatering	JOB	LS	$150,000.00	$150,000	1
Electrical Works	JOB	LS	$500,000.00	$500,000	1
Fish Screens	15,000	CFS	$10,000.00	$150,000,000	1
Miscellaneous Cost @10%				$800,000	
SUBTOTAL INTAKE FACILITIES				$158,800,000	
II. PUMPING PLANT					
Q= 15,000 cfs, TDH = 10', 11 ea. 2,280 HP unit (1 Stand-by)					
Pumps and Prime movers	JOB	LS	$35,864,000.00	$35,864,000	2
Structures and Improvements	JOB	LS	$19,544,000.00	$19,544,000	2
Electrical Equipment	JOB	LS	$3,698,000.00	$3,698,000	2
SUBTOTAL PUMPING PLANT				$59,106,000	
III. EARTH CANAL					
Embankment	12,106,000	CY	$2.00	$24,212,000	1
Compacted Embankment	2,648,000	CY	$0.80	$2,118,400	1
Common Embankment	1,334,000	CY	$0.50	$667,000	1
Strengthening of Existing Levee - North Levee of Grant Line Canal	40,000	LF	$319.32	$12,772,800	1
Fencing	146,000	LF	$5.00	$730,000	1
SUBTOTAL EARTH CANAL				$40,500,200	
IV. MIDDLE RIVER SIPHON					
6-30'x30' Concrete Box Including Rebar and Earthworks	24,800	CY	$600.00	$14,880,000	1
Transitions Concrete	7,000	CY	$600.00	$4,200,000	1
Riprap	20,000	CY	$50.00	$1,000,000	1
Dewatering	JOB	LS	$1,200,000.00	$1,200,000	1
Miscellaneous @ 5%				$1,064,000	
SUBTOTAL MIDDLE RIVER SIPHON				$22,344,000	

Table 2
ESTIMATED CAPITAL COSTS
MULITPLE INTAKES OPTION

DESCRIPTION	QUANTITY	UNIT[a]	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
V. OLD RIVER SIPHON TO CLIFTON COURT FOREBAY					
6- 30'x30' Concrete Box Including Rebar and Earthworks	74,400	CY	$600.00	$44,640,000	1
20'x50' Radial Gates	5	EA	$510,000	$2,550,000	1
Transitions Concrete	7,000	CY	$600.00	$4,200,000	1
Riprap	20,000	CY	$50.00	$1,000,000	1
Dewatering	JOB	LS	$1,200,000.00	$1,200,000	1
Miscellaneous @ 5%				$2,679,500	
SUBTOTAL OLD RIVER SIPHON				$56,269,500	
VI. FARM AND PRIVATE ROAD BRIDGES					
8 Bridges @ 12,000 sq. ft.	96,000	SF	$100.00	$9,600,000	1
SUBTOTAL FARM AND PRIVATE ROAD BRIDGES				$9,600,000	
VII. COUNTY ROAD BRIDGES					
One Bridge	16,800	SF	$100.00	$1,680,000	1
SUBTOTAL COUNTY ROAD BRIDGES				$1,680,000	
VIII. RELOCATION OF IRRIGATION DIVERSIONS AND DRAINAGE PUMPS					
Union Island	8350	AC	$1,000.00	$8,350,000	1
Miscellaneous @ 10%				$835,000	
SUBTOTAL RELOCATION OF IRRIGATION DIVERSIONS AND					
DRAINAGE PUMPS				$9,185,000	
X. LAND COST	3,352	AC	$3,000.00	$10,056,000	1
SUBTOTAL EASTERN INATAKE				**$367,540,700**	
CVP-SWP IMPROVEMENTS					
I. TRACY PUMPING PLANT					
Interconnection Channel with Gated Structures:					
2,800 lin. ft. of Earth Canal, Q=4,500 cfs:					
Excavation	375,000	CY	$2.00	$750,000	1
Compacted Embankment	486,000	CY	$0.80	$389,000	1

Table 2
ESTIMATED CAPITAL COSTS
MULITPLE INTAKES OPTION

DESCRIPTION	QUANTITY	UNIT[a]	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Common Embankment	203,000	CY	$0.50	$102,000	1
Borrow	557,000	CY	$5.00	$2,785,000	1
Land Cost	129	AC	$3,000	$387,000	1
Intake Structure with Radial Gates at Clifton Court Forebay	JOB	LS	$9,135,000	$9,135,000	3
Extra Set of Radial Gates Below Interconnection Channel	JOB	LS	$6,798,000	$6,798,000	1
Fish Screen at Tracy Pumping Plant	4,500	CFS	$10,000	$45,000,000	1
SUBTOTAL TRACY PUMPING PLANT				$65,346,000	
SUBTOTAL CVP - SWP IMPROVEMENTS				**$65,346,000**	
SUBTOTAL MULTIPLE INTAKE OPTION COST ITEMS				**$1,538,300,000**	
CONTINGENCIES @ 20%				$307,700,000	
SUBTOTAL				$1,846,000,000	
ENG., LEGAL, AND ADM. @ 35%				$646,100,000	
TOTAL PROJECT COST				**$2,492,100,000**	
TOTAL PROJECT COST RANGE					
LOW (-10%)				$2,243,000,000	
HIGH (+25%)				$3,115,000,000	

Footnotes:

[a]CY=cubic yard; LB=pound; EA=each; LS=lump sum; LF=linear foot; SF=square foot; TON=ton; MI=mile; AC=acre, CFS=cubic-feet-per-second

Cost Reference:

1. Cost developed by Bookman-Edmonston Engineering.
2. Cost developed for "Isolated Conveyance Facilities - 15,000 cfs" Cost Estimate
3. California Department of Water Resources, ISDP Cost Estimate: Proposed Clifton Court Forebay Northern Intake Structure, October 1993

Table 3
SUMMARY OF ESTIMATED CAPITAL COSTS
MULTIPLE INTAKES OPTION

Cost Item	Estimated Cost ($Millions)
Northern Intakes	
Intake Facilities - with Fish Screens	158.8
Pumping Plant	59.1
Earth Canal	125.2
Middle River Siphon	61.4
Old River Siphon	53.6
West Canal Siphon	40.6
County Road Bridges	1.7
Farm and Private Road Bridges	9.6
Railroad Bridge	2.5
Land Cost	10.2
Subtotal	**522.7**
Western Intakes	
Intake Facilities - with Fish Screens	158.8
Strengthening of Existing Levees	18.1
Construction of New Setback Levees	64.7
Modelumne River Aqueduct and R.R. Siphon	105.0
Indian Slough Siphon	56.2
Old River and Highway 4 Bridge Siphon	57.5
Old River Siphon into Clifton Court Forebay	109.1
Relocation of Irrigation Diversions and Drainage Pumps	9.2
Land Cost	4.1
Subtotal	**582.7**
Eastern Intakes	
Intake Facilities - with Fish Screens	158.8
Pumping Plant	59.1
Earth Canal	40.5
Middle River Siphon	22.3
Old River Siphon	56.3
Farm and Private Road Bridges	9.6
County Road Bridges	1.7
Relocation of Irrigation Diversions and Drainage Pumps	9.2
Land Cost	10.1
Subtotal	**367.6**
CVP-SWP Improvements	
Clifton Court Forebay-Delta-Mendota Canal Interconnection	20.3
Tracy Pumping Plant Fish Screens	45.0
Subtotal	**65.3**
TOTAL	**1,538.3**
Contingencies (20%)	307.7
ESTIMATED CONSTRUCTION COST	1,846.0
Engineering, Legal, and Project Administration (35%)	646.1
ESTIMATED CAPITAL COST	**2,492.1**
Capital Cost Range (minus 10% - plus 15%)	$2,243 - $3,115

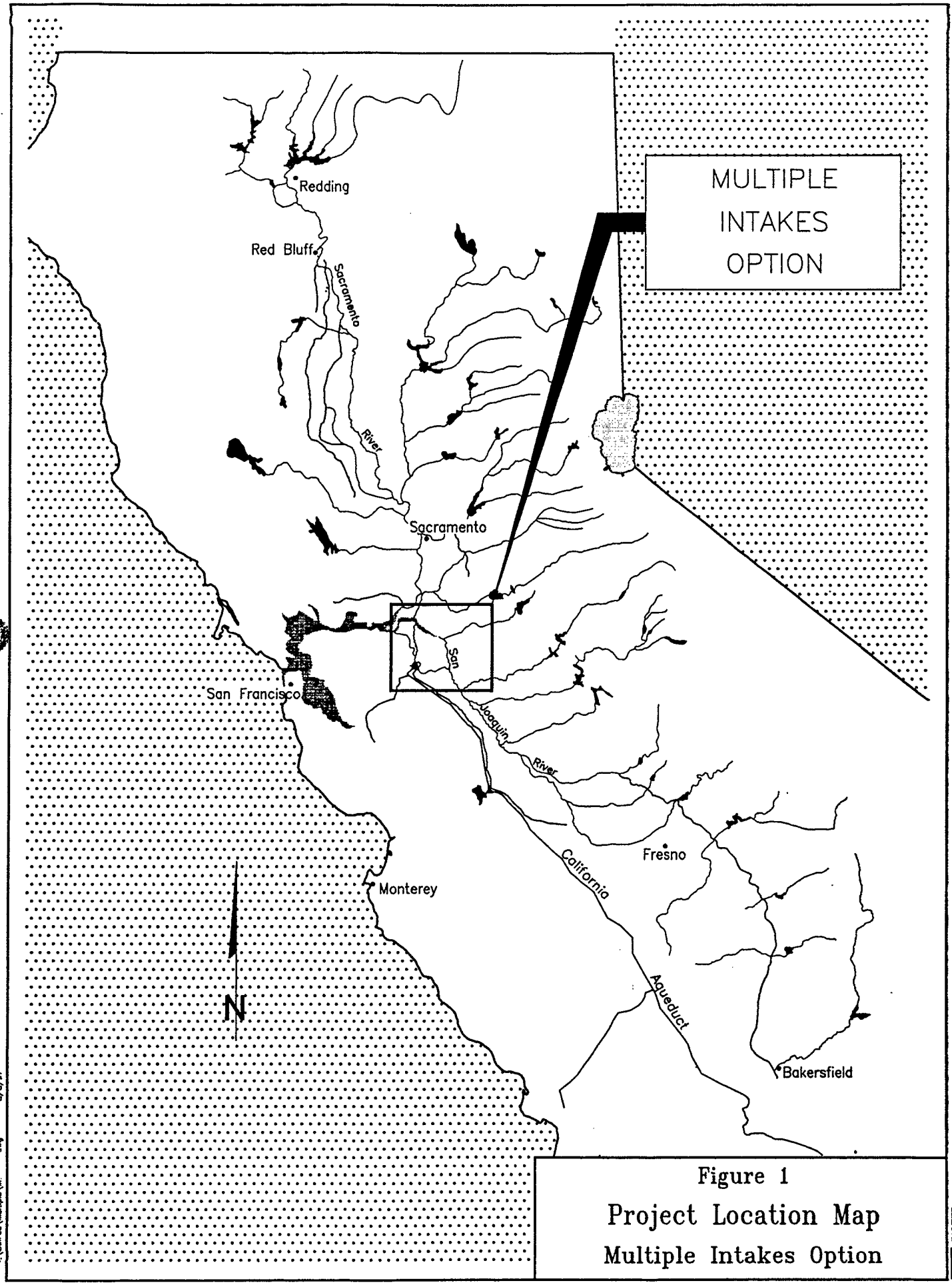

Figure 1

Project Location Map

Multiple Intakes Option

CALFED BAY-DELTA PROGRAM

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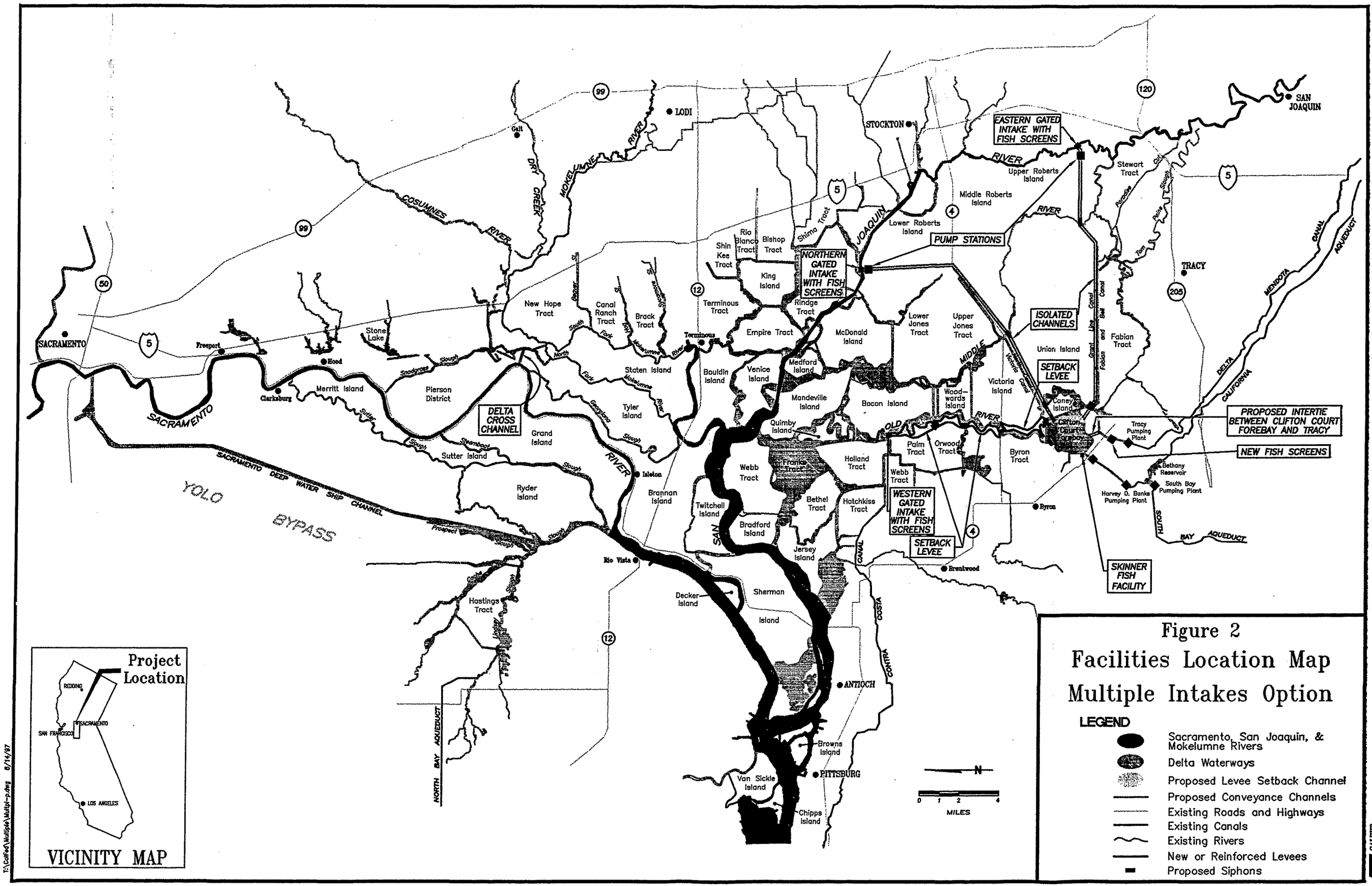

Figure 2
Facilities Location Map
Multiple Intakes Option

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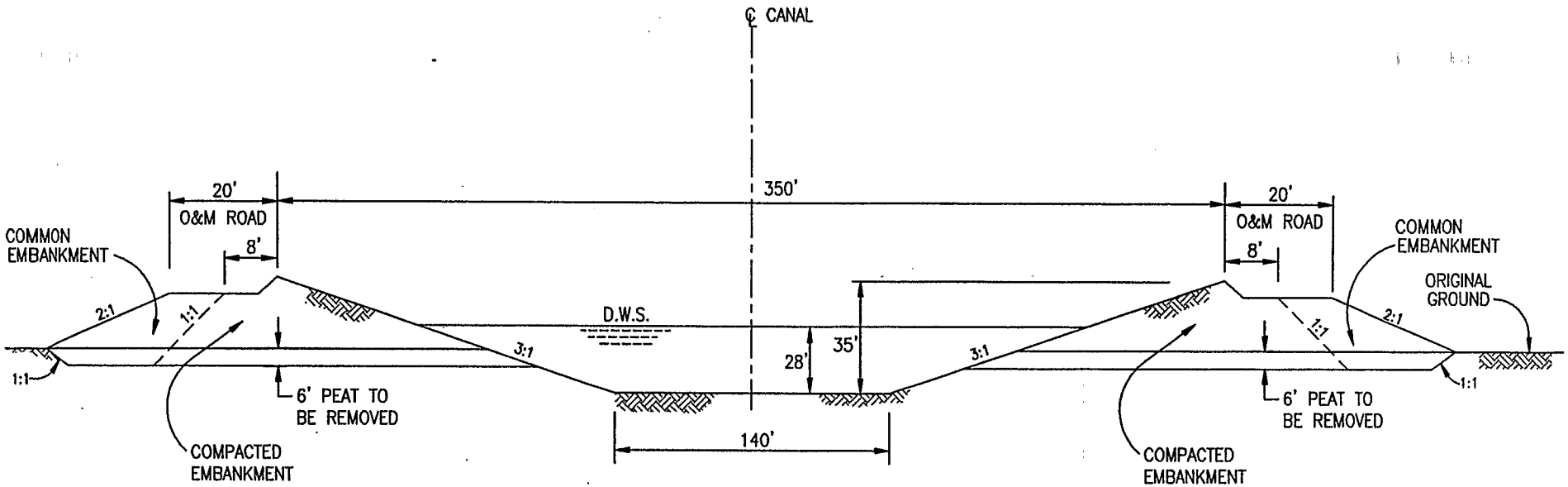


TYPICAL CANAL SECTION

NORTHERN ISOLATED SOUTH DELTA INTAKE

NOT TO SCALE

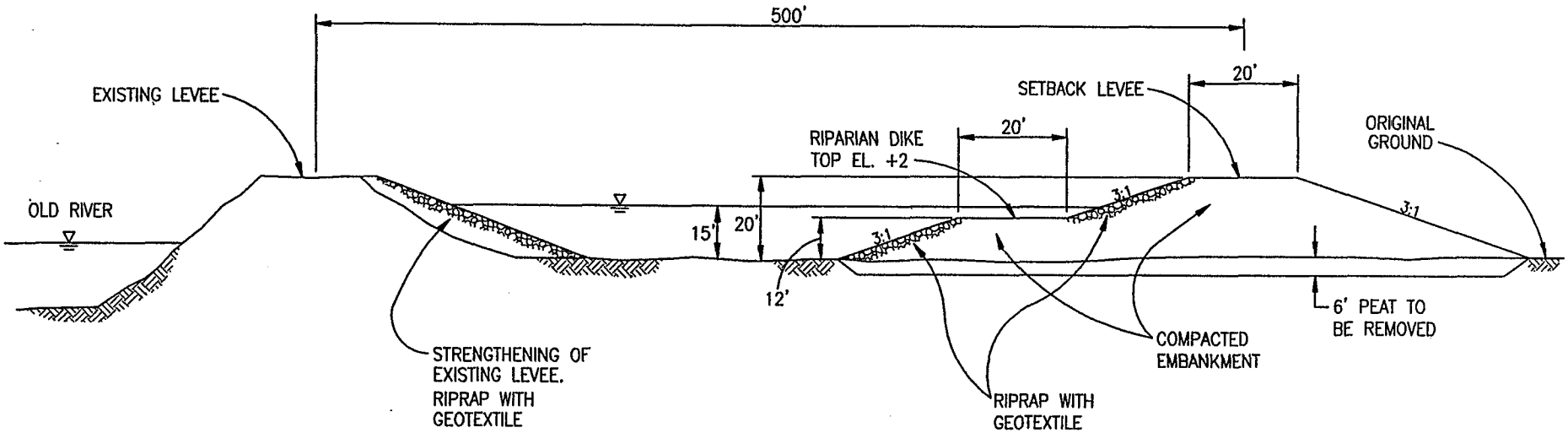
Figure 3

Typical Canal Section–Northern Intake

Multiple Intakes Option

CALFED BAY-DELTA PROGRAM

D—008906



TYPICAL SECTION

WESTERN ISOLATED SOUTH DELTA INTAKE

NOT TO SCALE

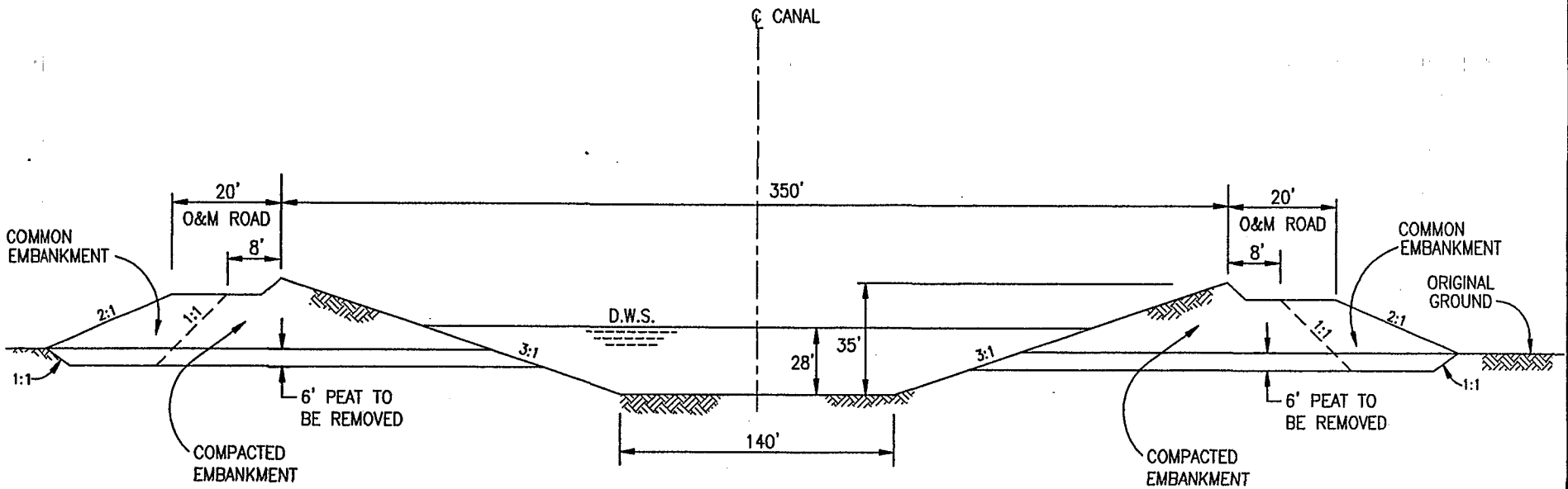
Figure 4

Typical Canal Section–Western Intake

Multiple Intakes Option

CALFED BAY-DELTA PROGRAM

D—008907



TYPICAL CANAL SECTION

EASTERN ISOLATED SOUTH DELTA INTAKE

NOT TO SCALE

Figure 5

Typical Canal Section–Eastern Intake

Multiple Intakes Option

CALFED BAY–DELTA PROGRAM

FACILITY DESCRIPTIONS AND UPDATED COST ESTIMATES FOR AN IMPROVED THROUGH DELTA CONVEYANCE FACILITY

Prepared by the CALFED Storage and Conveyance Refinement Team
October 1997

D-008910

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INTRODUCTION

The *Facility Descriptions and Updated Cost Estimates for an Improved Through Delta Conveyance Facility* has been prepared as part of the Storage and Conveyance Component Refinement Task of the CALFED Bay-Delta Program (CALFED or Program). CALFED's mission is to develop a long-term comprehensive plan that will restore the ecological health and improve water management for beneficial uses of the San Francisco Bay/Sacramento-San Joaquin Delta (Bay-Delta) system.

This report summarizes the principal features, estimated costs, and environmental considerations of modifying the hydraulic configuration of the Sacramento-San Joaquin Delta (Delta) to improve the conveyance capacity through the Delta from the Sacramento River to Clifton Court Forebay. The general location of the Delta is shown on Figure 1. This evaluation and others being performed by CALFED are intended to provide facility descriptions and updated cost estimates of representative storage and conveyance components. The objectives of the Improved Through Delta Conveyance Facility evaluation are to (1) provide an updated cost estimate which represents a cost within the range expected if the project were to be constructed today and (2) enable CALFED to compare this project against other projects that might be considered as part of a long-term CALFED solution strategy.

The cost estimate for the Improved Through Delta Conveyance Facility was determined by reviewing, adapting, and escalating costs presented in the California Department of Water Resource's (DWR) and the U.S. Bureau of Reclamation's (Reclamation) July 1996 *Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS) — Interim South Delta Program (ISDP)* and DWR's November 1990 *Draft Environmental Impact Report/ Environmental Impact Statement — North Delta Program.* A significant portion of the cost estimate is also based on unit costs and quantities developed by Bookman-Edmonston

Engineering. Modifications to previous cost estimates have been made where appropriate to reflect current design and safety standards.

A preliminary evaluation of the environmental considerations associated with the Improved Through Delta Conveyance Facility has been included in this report. Fish, wildlife, plant, and cultural resources that could be affected have been described and potential impacts have been identified. The information for the evaluation of environmental considerations was gathered from existing literature and databases.

PROJECT BACKGROUND

Development of the Delta began in the 19th century. Reclamation of Delta marshlands began in the 1850s, and by the 1930s, nearly all of the Delta had been reclaimed into intensively farmed islands. Ocean salinity intrusion to the interior of the Delta was observed as early as the 1840s and was recognized as a potential threat to water supplies. Since that time, there have been numerous studies of methods to control salinity intrusion and to otherwise improve the management of the water resources of the Delta.

In 1960, California voters approved the Burns-Porter Act to assist in the financing of the State Water Project (SWP). This Act authorized Delta facilities "... for water conservation, water supply in the Delta, transfer of water across the Delta, flood and salinity control, and related functions." In the same year, DWR proposed the Delta Water Project to serve as the Delta water facility of the SWP. This plan, however, was met with stiff opposition from Delta water users, boaters, fish and wildlife agencies, and other Delta interests. In 1965, the Interagency Delta Commission (comprised of DWR, California Department of Fish and Game [CDFG], Reclamation, and the U. S. Army Corps of Engineers) recommended the "Peripheral Canal" as an acceptable plan for water transfers across the Delta. The Peripheral Canal would convey water from the Sacramento River at Hood to the State and federal pumping plants in the south

Delta while minimizing interference with Delta waterways and releasing freshwater to Delta channels to maintain water quality and mitigate impacts to fish.

While DWR and Reclamation accepted and supported the construction of the Peripheral Canal as a joint-use facility of the SWP and the Central Valley Project (CVP), the facility was never constructed, partly for the following reasons:

- Although Reclamation and the Department of the Interior (Interior) embraced the concept of the facility in 1969, federal funding was never forthcoming.

- There was continuing fear of and controversy over the cost of the facility and of potential harm to the Bay-Delta from improper operation; some water users believed that water could be obtained at a lower cost; other Delta interests feared that guarantees for Delta protection could be changed or ignored during times of shortage.

DWR began reassessing the Peripheral Canal in 1975, resulting in Bulletin 76 (DWR, July 1978), which identified and considered numerous alternative water transfer facilities. In 1980, the State Legislature passed and then-Governor Brown signed Senate Bill (SB) 200. This bill authorized the Peripheral Canal and provided specific guarantees to protect the Delta and to meet the water needs of the SWP through the year 2000. SB 200 was subjected to a referendum vote in June 1982, which California voters did not approve.

As part of a continuing effort to better manage the Delta, DWR and Reclamation have conducted several studies over the past decade. In November 1990, DWR completed the *Draft Environmental Impact Report/Environmental Impact Statement — North Delta Program*, which addressed issues surrounding the northern and central portions of the Delta. The North Delta Program (NDP) had five objectives: (1) alleviate flooding in the northern portion of the Delta;

(2) reduce reverse flows in the lower San Joaquin River; (3) improve water quality; (4) reduce fishery impacts; and (5) improve SWP flexibility and water supply reliability.

In July 1996, DWR and Reclamation jointly released the *Draft Environmental Impact Report/ Environmental Impact Statement (EIR/EIS) — Interim South Delta Program (ISDP).* The ISDP had two objectives: (1) to improve water levels and circulation in south Delta channels for local agricultural diversions and (2) to improve south Delta hydraulic conditions to increase diversions into Clifton Court Forebay to maximize the frequency of the full pumping capacity of Banks Pumping Plant. Various elements of the North Delta Program and the ISDP have been incorporated into the following evaluation of the Improved Through Delta Conveyance Project.

During the ongoing CALFED Bay-Delta Program, some stakeholders have suggested that the current Delta configuration consisting primarily of riprapped channels and islands devoted to agriculture should be dramatically altered to restore aquatic habitat diversity and productivity. This would be achieved by acquiring large tracts of Delta agricultural land to create a diverse mix of aquatic, wetland, and riparian habitats; it would also slow the net cross-Delta transport velocities induced by State and federal export pumps.

CALFED staff has modified this conceptual approach to address a variety of other potential issues, including operational flexibility, flood control, existing infrastructure, and geologic conditions. The result is the proposal for two through-Delta conveyance facilities described in the following paragraphs.

FACILITIES DESCRIPTION

The following section provides an overview of the major features of the Improved Through Delta Conveyance Facility. Two alterative configurations for this project were developed by CALFED and Bookman-Edmonston Engineering. These alternative configurations have been designed to

achieve increased conveyance capacity and operational flexibility for moving water through the Delta from the Sacramento River to Clifton Court Forebay, while providing opportunities for extensive habitat restoration within the Delta.

OVERVIEW

The Improved Through Delta Conveyance Facility would be located in portions of the Delta lying in Sacramento, San Joaquin, and Contra Costa Counties (see Figure 1). The two alternative configurations for this project are referred to as the Hood Intake Alternative and the Tyler Island Alternative, shown in Figures 2 and 3, respectively. These alternatives share many common features including:

- South Delta Improvements including (1) a setback channel on Palm and Orwood Tracts and on Victoria Island, (2) a new intake to Clifton Court Forebay, (3) improved fish screens at the Skinner Fish Facility and the Tracy Pumping Plant, and (4) a new connection between Clifton Court Forebay and the Tracy Pumping Plant Intake.

- The McCormack-Williamson Tract Habitat and Floodway.

- The Bouldin Island Waterway.

The Hood Intake Alternative (Figure 2) would increase the conveyance capacity through the Delta by constructing a new intake and open channel from the Sacramento River through Snodgrass Slough to the Mokelumne River. The conveyance capacity of Snodgrass Slough and the Mokelumne River would be increased to accommodate increased flows. In this alternative, Bouldin Island would be converted to a waterway to increase the conveyance capacity from the

Mokelumne and Sacramento Rivers to the San Joaquin River and the central Delta. Bouldin Island would also function as extensive low velocity aquatic habitat.

The Tyler Island Alternative (Figure 3) would increase the conveyance capacity through the Delta by widening Georgiana Slough at its confluence with the Sacramento River and converting Tyler Island into low velocity aquatic habitat. This alternative would also include the conversion of Bouldin Island into low velocity aquatic habitat and the conversion of McCormack-Williamson Tract into wetland habitat. Conversion of the McCormack-Williamson Tract would also provide additional floodway capacity for the Cosumnes and Mokelumne Rivers.

PRINCIPAL FACILITIES

The Improved Through Delta Conveyance Facility alternatives vary in their configurations of the north and central Delta channel and island modifications. Modifications in the south Delta are identical in both alternatives; therefore, the following description of the principal facilities is divided into three sections: South Delta Improvements, Hood Intake Alternative, and Tyler Island Alternative.

The South Delta Improvements section provides a description of the proposed modifications to the SWP and CVP Delta pumping facilities and modification to the Old River channel to increase the conveyance capacity from the central Delta into Clifton Court Forebay. The Hood Intake Alternative section provides a description of the proposed modifications to the north and central Delta, including a new intake channel from the Sacramento River, near the community of Hood, to Snodgrass Slough and the Mokelumne River. The Tyler Island Alternative section provides a description of the proposed modification to the north and central Delta including the conversion of Tyler Island into low velocity aquatic habitat, which would provide increased conveyance capacity across the central Delta.

South Delta Improvements

The objectives of the South Delta Improvements in both the Hood Intake and Tyler Island Alternatives are to increase the aquatic habitat quality and conveyance capacity from the central Delta to Clifton Court Forebay. This would be accomplished by constructing a new setback levee along Old River to carry additional flows to Clifton Court Forebay from the central Delta and to provide additional Delta aquatic habitat. The setback channel would cross Palm, Orwood, and Byron Tracts and then cross Old River to Victoria Island. A new intake structure would provide water to Clifton Court Forebay from the setback channel on Victoria Island. Modifications to the SWP and CVP Delta pumping facilities have been proposed to increase the efficiency of operations and reduce impacts to fisheries. Table 1 provides a summary of the physical characteristics of the South Delta Improvements.

Palm Tract

Approximately 1,000 acres along the eastern border of Palm Tract would be purchased to allow construction of a setback channel parallel to the Old River channel. The setback levee would be located approximately 3,000 feet west of the existing eastern levee. The levees on the north and south of the tract (between the setback levee and the Old River channel levee) would be removed to allow water to flow through the setback channel. The Old River channel levee would remain, although it would be reinforced with riprap to protect against wind and wave action.

Orwood Tract

A setback channel similar to that decribed for the Palm Tract would be constructed along the eastern side of Orwood Tract. The setback levee would be placed 3,000 feet to the west of the existing Old River channel levee. The levees on the tract's northern and southern sides between the setback levee and the Old River channel levee would be removed. The Mokelumne

Aqueduct, which crosses the northern end of the tract, would be elevated above the water line by placing it on a trestle.

Bryon Tract

The setback channel would be similar to the channel that would be constructed on Palm and Orwood Tracts. The setback levee would be placed 3,000 feet to the west of the existing Old River channel levee. On the north end of the tract, the existing levee between the Old River channel and the new setback levee would be removed to allow water to enter the channel. At the southern end of Bryon Tract, an additional levee would be constructed along the alignment of Highway 4, which would be placed on the levee. A 3,000-foot section of the existing Old River channel levee (from Highway 4 northward) would be removed to allow water to leave the setback channel and enter Old River. The setback channel would be continued on the opposite side of Old River on Victoria Island. The crossing to Victoria Island at this location would avoid impacts to and/or relocation of the new Old River Intake Pumping Station for the Los Vaqueros Reservoir being constructed by Contra Costa Water District.

Victoria Island

The setback channel on Victoria Island would parallel the Old River channel on the western border of the island. A new setback levee would begin at the Highway 4 crossing of Old River and continue to the south end of the island. The setback levee would be aligned approximately 3,000 feet to the east of the Old River channel levee. At the southern end of the Victoria Island setback channel, an intake structure and siphon beneath the Old River Channel would be constructed to deliver water into the Clifton Court Forebay.

SWP and CVP Delta Pumping Facility Improvements

Modifications at Clifton Court Forebay would include a new gated intake structure at the north end of the forebay, directly across from the setback channel on Victoria Island. This new intake would enable more rapid filling of Clifton Court Forebay from flows conveyed through the setback channel. The Skinner Delta Fish Protective Facility, which screens diversions for the SWP's Banks Pumping Plant, would be upgraded with state-of-the-art fish screens. The new screens would be of the folded-V type and would be designed under the guidance of the CDFG. Modifications to the SWP and CVP Delta pumping facilities would increase the operational flexibility of diversions from the Delta while reducing the impacts associated with these diversions.

An interconnection between Clifton Court Forebay and the lower portion of the Delta-Mendota Canal would also be constructed on the south side of the forebay. This interconnection would allow water stored in the forebay to be diverted to the CVP's Tracy Pumping Plant for pumping and delivery to the Delta-Mendota Canal. The interconnection would be gated to maximize the operational flexibility of the system. An additional gate would be constructed on the Delta-Mendota Canal just downstream of the interconnection. The gate on the Delta-Mendota Canal would enable flows to be released into the Delta-Mendota Canal from Clifton Court Forebay during low tide conditions. The existing fish screens associated with the Tracy Pumping Plant would be upgraded to state-of-the-art screens similar to those that would be installed at the Skinner facility.

Hood Intake Alternative

The Hood Intake Alternative (see Figure 2) has been designed to increase the channel conveyance capacity from the Sacramento River to the central Delta and from the central Delta to Clifton Court Forebay. The improvements in the south Delta were described in the previous

section. Table 2 provides a summary of the physical characteristics of the Hood Intake Alternative. The remainder of this section provides a description of proposed improvements in the northern and central Delta for the Hood Intake Alternative.

Sacramento River-Hood Intake

As the name of the alternative indicates, the major feature of this alternative would be a new intake to the central Delta from the Sacramento River near the community of Hood. The new intake channel would increase the conveyance capacity of Sacramento River flows into the central Delta. The intake facility would have a capacity of 10,000 cfs and would include a fish screening facility, a sedimentation basin, trash racks, a low-lift pump station, and a discharge facility to an open channel. The open channel would be approximately 18,400 feet long with a top width of 446 feet. The channel would discharge onto the western portion of Glanville Tract, east of Snodgrass Slough and south of Lambert Road. The discharge structure of the open channel would include radial gates. The western portion of Glanville Tract would be converted from its present uses (primarily agriculture and natural gas production) to a conveyance channel with aquatic habitat.

Glanville Tract Setback Channel

Approximately 730 acres of western Glanville Tract situated generally west of the Southern Pacific Railroad and east of Snodgrass Slough would be converted to a conveyance channel for flows carried through the Sacramento River-Hood Intake. A new setback levee would be constructed approximately 1,000 feet east of the existing western levee along Snodgrass Slough. Toward the southern end of the tract, the setback levee would cross the Southern Pacific Railroad and join the tract's existing southern levee. The Southern Pacific Railroad and Twin Cities Road would be placed on a trestle and causeway, respectively, where their alignments are within the setback channel.

The levees on the north and south ends of the tract would be removed to allow water to flow into and out of the channel. The western levee, however, would remain as a channel island to provide habitat. The southern end of the channel would discharge to the McCormack-Williamson Tract Floodway and Habitat and the beginning of the Mokelumne River Floodway.

Mokelumne River Floodway

The Mokelumne River Floodway would include the conversion of McCormack-Williamson Tract and portions of Staten Island and New Hope, Canal Ranch, Brack, and Terminous Tracts into either aquatic habitat, wetlands, or conveyance channel to improve the conveyance capacity of the Mokelumne River, as well as the capacity to handle peak flood flows.

McCormack-Williamson Tract Floodway and Habitat

The McCormack-Williamson Tract would be purchased and converted to floodway capacity for the Mokelumne and Cosumnes Rivers and into aquatic habitat. At the far eastern end of the tract, just west of Interstate 5, a 2,000-foot section of the existing levee would be removed to allow flows from the Mokelumne and Cosumnes Rivers to enter. As indicated previously, flows from the Sacramento River, via Glanville Tract, would enter the McCormack-Williamson Tract at its northwest corner through a 2,000-foot cut in the existing levee. Flows would exit the floodway through a 2,000-foot levee cut at the south end of the tract. Directly across from this levee cut would be a cut in the New Hope Tract levee to allow flows to enter the New Hope Tract Setback Channel. The remaining levees would not be reinforced because they are generally at elevations greater than sea level and would therefore not be exposed to continuous wave action.

New Hope Tract Setback Channel

The western portion of New Hope Tract would be purchased and converted to a setback channel to increase the conveyance capacity of the Mokelumne River. This increased conveyance capacity would be used to convey flood flows of the Mokelumne and Consumes Rivers and transfer flows from the Sacramento River. A new setback levee would be constructed north to south from the Mokelumne River to Beaver Slough approximately 2,000 feet east of the western levee of New Hope Tract. Existing levees on the far north and south ends of the setback channel would be removed where they would obstruct the flow of the channel. The existing western levee would be retained and reinforced as a channel island. At its southern end, the New Hope Tract Setback Channel would discharge into Beaver Slough and into Canal Ranch Tract, directly across Beaver Slough.

Canal Ranch Tract Wetlands

Canal Ranch Tract would be purchased and converted primarily to wetlands habitat with the exception of the western portion of the tract, which would provide conveyance capacity for flood and transfer flows. A 2,000-foot section of existing levee on the northwest corner of the tract would be removed to allow flows from the New Hope Tract Setback Channel to enter. At the southwest corner of the tract, a 2,000-foot section of existing levee would be removed to allow water to leave the tract and enter Hog Slough and Brack Tract. The interior of the existing levees would be protected with riprap to guard against wind and wave action.

Brack Tract Wetlands

Brack Tract would be configured similarly to Canal Ranch Tract and converted primarily to wetlands habitat. The western portion of the tract would be utilized to convey flood and transfer flows. A 2,000-foot section of levee on both the northern and southern end of the tract would be

removed to allow flows to enter and exit the tract. Water leaving the tract at the southern end would enter the Mokelumne River and the Terminous Tract/Staten Island Setback Channel. The remaining levees would be reinforced with riprap. The western levee would serve as a channel island.

Terminous Island/Staten Island Setback Channel

Approximately 220 acres of Terminous Tract and 315 acres of Staten Island would be purchased and converted to a setback channel for the lower South Fork Mokelumne River. A setback levee would be constructed on Terminous Tract from Sycamore Slough to the South Fork Mokelumne River. The existing levee between the setback levee and South Fork Mokelumne River would be removed to create a flow path. The remaining levee along Sycamore Slough would be reinforced. Seepage interception wells would be placed along the Sycamore Slough levee and the South Fork Mokelumne River levee.

The Staten Island setback levee would be constructed across the southeast corner of the island. The existing levee between the setback levee and the South Fork Mokelumne River would be removed to create a flow path. Seepage interception wells would also be placed along the setback levee. The combination of the Terminous Tract and Staten Island setback channels would create a channel approximately 4,000 feet wide. Some the existing levees within the new channel may be retained to provide channel island habitat.

Bouldin Island Habitat and Conveyance

Bouldin Island would be entirely converted from its present uses to shallow water-low velocity aquatic habitat and through Delta conveyance capacity. A 4,000-foot section of levee would be removed along the south bank of the South Fork Mokelumne River directly opposite the Terminous Tract/Staten Island Setback Channel. Highway 12 would be elevated for its entire

length across the island. The eastern portion of the highway (for approximately 2,000 feet) would be placed on a causeway to allow flood and transfer flows to move across the island. Flows would leave the island through a 4,000-foot cut in the levee on the southwest corner of the island. The cut would be made between Potato Slough and the Mokelumne River and would discharge flows directly into the San Joaquin River. The remaining levees would be reinforced with riprap on the interior sides to protect against wave and wind action.

Tyler Island Alternative

The Tyler Island Alternative (see Figure 3) would increase the capacity to move water through the Delta by constructing an intake channel from the Sacramento River into the central Delta. Tyler and Bouldin Islands would be converted into shallow water, low velocity aquatic habitat that would provide conveyance capacity for through Delta flows. Increased conveyance capacity in the south Delta would be accomplished with the channel improvements described in the South Delta Improvements description. Flood capacity on the lower Mokelumne River would be increased by converting McCormack-Williamson Tract and Dead Horse Islands into floodways. Table 3 provides a summary of the physical characteristics of the northern and central Delta improvements proposed under this alternative.

Sacramento River-Georgiana Slough Intake

To supplement the capacity of the Delta Cross Channel, the existing Georgiana Slough channel from the Sacramento River would be widened by constructing a setback levee on the northeast corner of Andrus Island. The setback levee would be located 500 feet west of the Georgiana Slough; existing levees between the slough and the setback levee that would obstruct flow would be removed. A portion of the Andrus Island levee within the setback channel would be converted to channel island habitat. Georgiana Slough would continue to carry water from the Sacramento River into the interior of the Delta. The enlarged Georgiana Slough channel would

lead to a proposed 600-foot weir (the North Weir) on the northwest portion of the Tyler Island. The North Weir would regulate flows into Tyler Island.

To prevent increased erosion of the Georgiana Slough channel bottom resulting from increased conveyance capacity from the Sacramento River, the channel bottom would be armored with riprap or gabion baskets where appropriate. In addition, a sediment control structure would be placed downstream of the North Weir on Tyler Island.

Tyler Island Habitat and Conveyance

Tyler Island would be converted from its present uses to shallow water-low velocity aquatic habitat. The island would also function as conveyance capacity for through Delta flows. The proposed North Weir, on the northwest corner of the island, would include an inflatable rubber dam to control the weir elevation and inflow rate from Georgiana Slough and the Sacramento River. An additional 2,000 feet of levee on the northeast corner of the island would be removed to allow flows to enter from the Delta Cross Channel, via Snodgrass Slough, and the Mokelumne River Floodway, which is described below. A new levee would be constructed from the North Weir to the levee breach on Snodgrass Slough to protect the very northern corner of Tyler Island, which includes the community of Walnut Grove.

Water would leave Tyler Island through a 2,000-foot levee cut at the south end of the island where the North Fork Mokelumne River and Georgiana Slough converge. From the outlet of Tyler Island, water would flow into Bouldin Island, which, in addition to providing aquatic habitat, would also provide additional through Delta conveyance capacity.

Bouldin Island Habitat and Conveyance

Bouldin Island would be entirely converted from its present uses to shallow water-low velocity aquatic habitat and through Delta conveyance capacity. A 3,000-foot section of levee would be removed on the east bank of the lower Mokelumne River, north of Highway 12. This levee cut would allow water from Tyler Island and the lower Mokelumne River to enter Bouldin Island. Highway 12 would be elevated for its entire length on the island. The western portion of the highway, for approximately 2,000 feet, would be placed on a causeway to allow flood and transfer flows to move across the island. Flows would leave the island through a 3,000-foot cut in the levee on the southwest corner of the island. The cut would be made between Potato Slough and the Mokelumne River and would discharge flows directly into the San Joaquin River. The remaining levees would be reinforced with riprap to protect against wind and wave action.

Mokelumne River Floodway

To improve the flood capacity of the lower Mokelumne River, the McCormack-Williamson Tract and Dead Horse Island would be converted to floodways and aquatic habitat. The entire McCormack-Williamson Tract would be purchased. At the far eastern end of the tract, just west of Interstate 5, a 2,000-foot section of the existing levee would be removed to allow flows from the Mokelumne and Cosumnes Rivers to enter. Flows would exit the floodway through a 2,000-foot levee cut on the southwest side of the tract. The cut would discharge into Dead Horse Cut, which connects Snodgrass Slough to the Mokelumne River. Directly across from this levee cut would be a cut in the Dead Horse Island levee to allow flows to enter that island.

The roughly 200 acres that comprise Dead Horse Island would be converted to floodway and aquatic habitat. Approximately 2,000 feet of existing levee on the eastern end of the island would be removed to allow flows to enter the island's interior. This levee cut would be made directly opposite the levee cut on the McCormack-Williamson Tract. On the southwest side of

the island, approximately 2,000 feet of levee would be removed to allow flows to exit the island. The outlet from the island would be directly across from the levee cut leading into Tyler Island from Snodgrass Slough. The interior sides of the remaining levees would be protected with riprap.

COST ESTIMATE

The Improved Through Delta Conveyance Facility is a new conceptual approach that has not been intensively studied in the past. There is no specific previous information describing or estimating the cost of this project. There are, however, some studies with similar components from which comparative costs were derived including the DWR and Reclamation July 1996 *Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS) — Interim South Delta Program (ISDP)*, DWR's November 1990 *Draft Environmental Impact Report/ Environmental Impact Statement — North Delta Program*, and the DWR 1995 report *Isolated Transfer Facility Cost Estimate*. This cost estimate has been developed primarily by Bookman-Edmonston Engineering and was based on applicable portions of the aforementioned studies, experience, and engineering judgment.

COST ESTIMATE METHODOLOGY

The estimated capital cost of the Improved Though Delta Conveyance Facility was determined by applying current unit costs to quantities developed by Bookman-Edmonston Engineering. Some of the costs used to prepare this cost estimate were determined by escalating the unit cost to October 1996 dollars using the Reclamation Construction Cost Trends (CCT) indices. Additional unit costs were developed by Bookman-Edmonston Engineering based on engineering and construction experience. The cost estimate does not include the cost of environmental documentation, environmental mitigation, operation and maintenance, power, and interest during construction.

Table 4 provides a detailed breakdown of the estimated capital costs of the Hood Intake Alternative and Table 5 provides a detailed breakdown of the Tyler Island Alternative. Cost items identified in previous cost estimates have been provided, along with the unit cost of the items or an indication that the estimated cost has been developed through a lump sum approach. The tables also include the Reclamation CCT index for the month and year in which the estimated cost was developed and for October 1996. These Reclamation cost indices are used to factor the previous cost estimate to October 1996 dollars. In some instances, only a unit cost has been provided, with no cost indices. In these cases, the unit cost has been taken from other sources. The far right-hand column of Tables 4 and 5 provides the cost reference for each cost item.

Pumping Plants

The cost estimates for the Improved Through Delta Conveyance Facility were based on the actual construction costs for the Waddell Pumping-Generating Plant in Arizona, which was completed in 1994. To develop costs for pumping plants in this evaluation, the actual construction cost of the Waddell Pumping-Generating Plant (escalated to October 1996 dollars) was factored by the following empirical equation:

$$\frac{(Cost)_1}{(Cost)_2} = \frac{HP_1^{6/10}}{HP_2^{6/10}}$$

where HP is equal to horsepower.

This cost factor formula is typically valid over moderate ranges in horsepower; the validity over larger ranges is undetermined. The impact of any error resulting from utilizing this ratio beyond its valid range is considered to be within the accuracy of the present cost estimate.

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Right-of-Way Costs

Right-of-way costs of $3,000 per acre were used based upon personal communication with Reclamation's Division of Land Resources staff in February 1997. The right-of-way necessary for the development of the Hood Intake Alternative would require purchasing approximately 28,900 acres in the Delta, resulting in an approximate right-of-way cost of $86.7 million. The Tyler Island Alternative would require the purchase of approximately 20,100 acres, resulting in an approximate right-of-way cost of $60.3 million.

Contingencies and Other Costs

All contingencies and engineering, construction management, and administrative factors were determined by engineering judgment based on a similar level of cost estimation. Contingencies were chosen to be 20 percent; engineering, construction management, and administration were chosen to be 35 percent. A cost range was developed for the project by subtracting 10 percent from the estimated capital cost for the low-end cost and adding 25 percent to the estimated capital cost for the high-end cost.

PRELIMINARY COST FINDINGS

The costs of the two alternatives of the Improved Through Delta Conveyance Facility and their supporting facilities have been developed to an October 1996 basis as described above. Table 6 summarizes estimated costs of the major items associated with the Improved Through Delta Conveyance Facility for both the Hood Intake Alternative and the Tyler Island Alternative.

The total capital cost of the Hood Intake Alternative, including the South Delta Improvements, is estimated to be about $1,435 million with a resulting calculated cost range between $1,292 and $1,794 million. The total capital cost of the Tyler Island Alternative, including the South Delta

Improvements, is estimated to be about $842 million with a resulting calculated cost range between $758 and $1,052 million.

The cost of the South Delta Improvement portion of each alternative is estimated to be $512 million, including 20 percent contingency and 35 percent engineering, construction management, and administrative cost factors. Using the method described above for calculating the cost range of the project, the range of costs for the South Delta Improvement component would be $461 to $640 million. The South Delta Improvements component accounts for approximately 36 percent of the total estimated capital cost of the Hood Intake Alternative and approximately 61 percent of the Tyler Island Alternative total estimated capital cost.

ENVIRONMENTAL CONSIDERATIONS

[NOTE: The environmental considerations section needs to be reevaluated by DWR to ensure consistency with the information presented in the previous section.]

This portion of the report provides a summary of environmental considerations related to the minimum change through Delta conveyance option. Fish, wildlife, plant, and cultural resources that could be affected by the proposal are described and the extent of the impacts identified. The information presented in this section was gathered from existing literature, with limited original research. No field work was conducted for this analysis.

WILDLIFE

This conveyance option would impact 500 acres of agricultural land. No riparian areas would be impacted.

Fish, Amphibians, Reptiles, and Invertebrates

The Delta supports several types of aquatic habitats including estuary, freshwater, and marine water environments. These various water environments support about 90 species of fish.

During construction, the conveyance options could affect several waterways that support both anadromous and resident game and non-game fish. Fish dependant on the Delta as a migration corridor, nursery, or permanent residence include striped bass, chinook salmon, steelhead trout, American shad, sturgeon, catfish, largemouth bass, winter-run chinook salmon, delta smelt, Sacramento splittail, and numerous other marine and freshwater species.

Amphibians in the area include the California tiger salamander, which requires quiet, still water for breeding. The major waterways in the area are too deep, swift, and subject to frequent inundation to provide suitable habitat for this species.

General Wildlife

Lands within the areas of the proposed Improved Through Delta Conveyance Facility support a highly diverse wildlife. Important groups of wildlife dependant on the Delta environment are waterfowl and other migratory birds, game birds such as pheasant and quail, furbearers, and numerous nongame birds and mammals. The Delta is particularly important to waterfowl migrating via the Pacific Flyway. The principal attraction for waterfowl is winter flooded agricultural fields that provide food and extensive seasonal wetlands. Small mammals find suitable habitat in the Delta and upland areas. Vegetated levees, riparian forest, and undeveloped islands provide habitat for numerous small mammals. Small mammal species include muskrat, mink, river otter, beaver, raccoon, gray fox, and skunk. A variety of nongame wildlife such as songbirds, hawks, owl, reptiles, and amphibians can also be found in the area.

Sensitive and Listed Fish and Wildlife Species

According to the Department of Fish and Game's California Natural Diversity Database, listed wildlife species recorded in or around the area that would be affected by the proposed conveyance option include California red-legged frog (federal threatened), Swainson's hawk (State threatened), California black rail (State threatened), San Joaquin kit fox (federal endangered, State threatened), giant garter snake (federal/State threatened), and valley elderberry longhorn beetle (federal threatened).

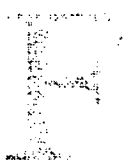
Wildlife species that are either candidates for State and federal listing or considered species of special concern by the CDFG and that have been known to occur in or near the area affected by either of the proposed through Delta conveyance alternatives include California tiger salamander (federal candidate/CDFG species of special concern), great blue heron, great egret, white-tailed kite, burrowing owl (CDFG/Audubon species of special concern), tricolored blackbird (federal candidate/CDFG species of special concern), Sacramento splittail (federal proposed endangered/ CDFG species of special concern), San Joaquin pocket mouse (CDFG species of special concern), and western pond turtle (federal candidate/CDFG species of special concern).

Other sensitive wildlife species that are candidates for federal listing and that have not been previously recorded, but may be present in the area of the proposed conveyance alignment, include the San Joaquin valley wood rat, riparian brush rabbit, greater western mastiff bat, small-footed myotis bat, long-eared myotis bat, fringed myotis bat, long-legged myotis bat, Yuma myotis bat, Pacific western big-eared bat, bells sage sparrow, western burrowing owl, ferruginous hawk, mountain plover, little willow flycatcher, white faced ibis, silvery legless lizard, southwestern pond turtle, San Joaquin whipsnake, California horned lizard, western spadefoot toad, green sturgeon, river lamprey, Kern brook lamprey, Pacific lamprey, longfin smelt, Antioch Dunes anthicid beetle, Sacramento anthicid beetle, and molestan blister beetle.

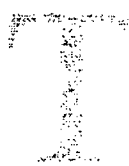
Limited sporadic use of the project area may occur for wintering greater sandhill cranes. This species (State threatened) is a common winter migrant to the eastern Sacramento Valley. While the crane does not nest in the project area, it could use the open grasslands for foraging.

Bald eagle, peregrine falcon, yellow-billed cuckoo, and Aleutian Canada goose have been observed in the Delta, but none are confined exclusively to the area.

Habitat suitable for the California black rail can be found in the area of Little Potato Slough at its confluence with White Slough and on the islands in the Middle River area north of Woodward Ferry.



Suitable habitat for western pond turtles occurs along all watercourses in the area. Previous surveys have recorded turtles in Lost Slough, Snodgrass Slough, South Fork Mokelumne River, and Old and Middle Rivers.



Elderberry is widely distributed and is a common component of the mixed riparian woodland community of the Delta. These plants are considered potential habitat for the valley elderberry longhorn beetle.

VEGETATION

This Delta conveyance option would affect approximately 500 acres of agricultural lands. No riparian lands would be affected by this option.

Sensitive and Listed Plant Species

A federal candidate, State-listed rare plant, Mason's lilaeopsis, has been known to occur in the area that could be affected by the proposed through Delta conveyance option.

Candidate plant species for federal listing that may occur in the project area include Suisun Marsh aster, caper-fruited tropidocarpum, San Joaquin saltbush, Ferris's milk vetch, Delta tule pea, and recurved larkspur.

Additional plants listed by the California Native Plant Society as being rare, threatened, or endangered in California and elsewhere could also be affected by the proposed through Delta conveyance option. These plants include big tarweed, Wright's trichocoronis, marsh skullcap, California hibiscus, heartscale, Delta mudwort, and bristly sedge.

Special-status habitats that may be found along or near the area of the proposed project include valley sink scrub, northern hardpan vernal pool, northern claypan vernal pool, alkali meadow, coastal and valley freshwater marsh, Great Valley mixed riparian forest, Great Valley oak riparian forest, and Valley Oak woodland.

Wetlands

Information gathered from the the U.S. Fish and Wildlife Services's National Wetland Inventory map indicates that within the area that would be affected by the proposed conveyance option, there are 19 miles of farmed wetlands, six miles of scrub-shrub seasonal tidal wetlands, two acres of emergent seasonally flooded wetlands (shallow marsh), two acres of emergent tidal wetlands, three farm ponds, and two drainage canals. This alternative would cross Snodgrass Slough, a scrub-shrub tidal wetland.

Four special-status wetland habitats (northern hardpan vernal pool, northern claypan vernal pool, alkali meadow, and coastal and valley freshwater marsh) could be affected by the proposed Through Delta Conveyance options.

CULTURAL RESOURCES

Generally, archaeological sites throughout the Delta province may be over-represented. Historical activities connected with channel dredging, levee construction and maintenance, residential development, and agriculture have obscured, buried, and destroyed many sites since the first half of the twentieth century, when most were first found. Additionally, some may now be buried under alluvium.

Prehistoric settlements in the Delta were situated on low rises above flood level, mounds on low knolls, natural levees, and higher ground along the banks of streams and rivers. Reclamation and farming activities have leveled most of these areas of higher relief. Field inspection will be necessary to verify the existence and condition of these sites for a more accurate assessment.

Historic period sites and features in the Delta province are generally under-represented. The surveys responsible for identifying most of the archaeological sites were carried out by the University of California at Berkeley during the time when there was little concern for historic period resources. Almost all of them have been recorded since the 1970s.

In addition to farmsteads, ranches, and townsites, other resources noted on the quadrangle maps will require evaluation. These resources include levees, pumphouses, pumping stations, windmills, railroad grades, roads, bridges, pilings, piers, landings, and gas wells.

Review of the base maps and site records at the North Central (CSU at Sacramento), Central California (CSU at Stanislaus), and Northwest (Sonoma State University) Information Centers indicates that this option may affect 35 known cultural resources. One of the sites is a small remnant of an important prehistoric site (non-significant), noted as almost completely destroyed in 1932.

Fifteen non-significant historic sites could be affected by the project. They consist of a landing, pumping station, concrete abutment, bridge, trash scatters, and the remains of a residence and farm buildings. Six sites associated with George Shima's agricultural operations represent a labor camp for Asian farm workers during the 1900-1920 period. Individually, these sites are not significant, but collectively are probably eligible for listing on the National Register of Historic Places (NRHP) as an Historic District.

Nineteen significant prehistoric sites could be affected by this option. Two have been determined to be eligible for listing on the NRHP. Eleven have human remains, in some cases with a midden deposit, and eight have a midden deposit with no known human remains. There is one ethnographic site, named Plains Miwok village, which correlates with one of the prehistoric archeological sites.

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Table 1
Summary of Physical Characteristics
Improved Through Delta Conveyance - South Delta Improvements

Old River Conveyance Capacity Improvements - Setback Channel		
Palm Tract		
Land Acquisition (acres)		1,047
Length of New Setback Levees (feet)		12,000
Length of Reinforced Levees (feet)		20,200
Orwood Tract		
Land Acquisition (acres)		690
Length of New Setback Levees (feet)		7,600
Length of Reinforced Levees (feet)		10,600
Byron Tract		
Land Acquisition (acres)		1,102
Length of New Setback Levees (feet)		10,200
Length of Reinforced Levees (feet)		11,400
Victoria Island		
Land Acquisition (acres)		546
Length of New Setback Levees (feet)		12,400
Length of Reinforced Levees (feet)		13,000
SWP and CVP Delta Pumping Facility Improvements		
New Clifton Court Intake From Victoria Island Setback Channel		
Capacity (cfs)		15,000
Siphon Length (feet)		1,400
Number of Radial Gates		2
New Interconnection Between Clifton Court Forebay and Delta-Mendota Canal		
Capacity (cfs)		10,300
Number of Radial Gates		2
New Radial Gate Control Structure on Delta-Mendota Canal		
Capacity (cfs)		10,300
Number of Radial Gates		2
Upgraded Fish Screens at Skinner Delta Fish Protection Facility		
Screen Type		Folded-V
Capacity (cfs)		
Upgraded Fish Screens at Tracy Pumping Plant		
Screen Type		Folded-V
Capacity (cfs)		4,500
Total Land Acquisition (acres)		3,385
	Feet	**Miles**
Total New Setback Levees	42,200	8.0
Total Reinforced Levees	55,200	10.5

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Table 2
Summary of Physical Characteristics
Improved Through Delta Conveyance - Hood Intake Alternative

Conveyance/Habitat Improvements	
Sacramento River - Hood Intake	
Intake Facilty	
Pumping Plant Capacity (cfs)	10,000
Fish Screen Type	Folded-V
Land Acquisition (acres)	55
Open Channel	
Capacity (cfs)	10,000
Length (feet)	18,400
Land Acquisition (acres)	400
Glanville Tract Setback Levee	
Land Acquisition (acres)	730
Length of New Setback Levees (feet)	6,000
Length of Reinforced Levees (feet)	26,800
New Railroad Trestle for Southern Pacific RR (length - feet)	1,300
New Elevated Causeway for Twin Cities Road (length - feet)	1,000
McCormack-Williamson Tract Floodway and Habitat	
Land Acquisition (acres)	1,630
Length of New Setback Levees (feet)	0
Length of Reinforced Levees (feet)	0
New Hope Tract Setback Channel	
Land Acquisition (acres)	3,800
Length of New Setback Levees (feet)	19,000
Length of Reinforced Levees (feet)	43,600
New Bridge for Walnut Grove Road (length - feet)	2,000
Canal Ranch Tract Wetlands	
Land Acquisition (acres)	5,850
Length of New Setback Levees (feet)	0
Length of Reinforced Levees (feet)	45,400
Brack Tract Wetlands	
Land Acquisition (acres)	6,600
Length of New Setback Levees (feet)	0
Length of Reinforced Levees (feet)	48,200
Terminous Island/Staten Island Setback Channel	
Land Acquisition (acres)	535
Length of New Setback Levees (feet)	9,600
Length of Reinforced Levees (feet)	10,200
Bouldin Island Habitat and Conveyance	
Land Acquisition (acres)	5,913
Length of New Setback Levees (feet)	0
Length of Reinforced Levees (feet)	86,000
New Elevated Roadway for Highway 12 (length - feet)	22,000
New Causeway for Highway 12 (length - feet)	2,000

Table 2 (Continued)
Summary of Physical Characteristics
Improved Through Delta Conveyance - Hood Intake Alternative

Summary		
Total Land Acquisition		
South Delta Improvements (Table 1)		3,385
Hood Intake Alternative		25,513
Total		28,898
Total Miles of New Levees	Feet	Miles
South Delta Improvements (Table 1)	42,200	8.0
Hood Intake Alternative	34,600	6.6
Total	76,800	14.5
Total Miles of Reinforced Levees		
South Delta Improvements (Table 1)	55,200	10.5
Hood Intake Alternative	260,200	49.3
Total	315,400	59.7

Table 3
Summary of Physical Characteristics
Improved Through Delta Conveyance - Tyler Island Alternative

Conveyance/Habitat Improvements	
Sacramento River - Georginiana Slough Intake	
Andrus Island Setback Channel	
Land Acquisition (acres)	125
Length of New Setback Levees (feet)	700
Length of Reinforced Levees (feet)	2,200
Andrus Island Road Modification	
Elevated Roadway (length - feet)	3,600
Bridge (length - feet)	700
Tyler Island Habitat and Conveyance	
Land Acquisition (acres)	8,818
Length of New Setback Levees (feet)	4,400
Length of Reinforced Levees (feet)	112,400
Tyler Island Road Modification	
Elevated Roadway (length - feet)	500
Bridge (length - feet)	600
Thorton-Walnut grove Road Modification	
Bridge (length - feet)	1,000
Bouldin Island Habitat and Conveyance	
Land Acquisition (acres)	5,913
Length of New Setback Levees (feet)	0
Length of Reinforced Levees (feet)	89,000
New Elevated Roadway for Highway 12 (length - feet)	22,000
New Causeway for Highway 12 (length - feet)	2,000
Mokelumne River Floodway	
McCormack-Williamson Tract Floodway	
Land Acquisition (acres)	1,630
Length of New Setback Levees (feet)	0
Length of Reinforced Levees (feet)	0
Dead Horse Island Floodway	
Land Acquisition (acres)	225
Length of New Setback Levees (feet)	0
Length of Reinforced Levees (feet)	11,600
Summary	
Total Land Acquisition	
South Delta Improvements (Table 1)	3,385
Tyler Island Alternative	16,711
Total	**20,096**
Total Miles of New Levees	**Feet** / **Miles**
South Delta Improvements (Table 1)	42,200 / 8.0
Tyler Island Alternative	5,100 / 1.0
Total	47,300 / 9.0
Total Miles of Reinforced Levees	
South Delta Improvements (Table 1)	55,200 / 10.5
Tyler Island Alternative	215,200 / 40.8
Total	270,400 / 51.2

Table 4
Estimated Capital Costs
Improved Through Delta Conveyance - Hood Intake Alternative

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX APR. 91	USBR INDEX OCT. 96	UNIT COST APR. 91	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
NORTH DELTA								
I. INTAKE STRUCTURE								
Remove Existing Levee (Sacramento River)								
Embankment	52,800	CY	163	181	$4.00	$4.44	$234,523	2, page 439
Riprap	1,870	TONS	163	181	$7.50	$8.33	$15,574	2, page 439
Bridge (Hwy. 160)	42,000	SF				$100.00	$4,200,000	3
Intake Structure	JOB	LS				$79,800,000	$79,800,000	5
Fish Screens	10,000	CFS				$10,000	$100,000,000	3
Low Lift Pumping Plant (Q=10000 CFS)	JOB	LS				$49,342,000	$49,342,000	6
Channel	18,400	LF				$581.00	$10,690,400	3
Land Acquisition	455	AC				$3,000.00	$1,365,000	1
Bridge (Lambert Rd.)	42,000	SF				$100.00	$4,200,000	3
Discharge Structure Including Radial Gate Structure	JOB	LS				$7,580,000.00	$7,580,000	3
SUBTOTAL INTAKE AND CHANNEL							$257,427,496	
II. GLANVILLE TRACT								
Land Acquisition	730	AC				$3,000.00	$2,190,000	1
Remove Existing Levee (Northern End)								
Embankment	124,800	CY	163	181	$4.00	$4.44	$554,326	2, page 439
Riprap	4,420	TONS	163	181	$7.50	$8.33	$36,811	2, page 439
Remove Existing Levee (Southern End)								
Embankment	211,200	CY	163	181	$4.00	$4.44	$938,091	2, page 439
Riprap	7,500	TONS	163	181	$7.50	$8.33	$62,462	2, page 439
New Levee								
Embankment	307,000	CY	163	181	$7.00	$7.77	$2,386,313	2, page 439
Levee Foundation	214,000	CY	163	181	$9.80	$10.88	$2,328,793	2, page 437
Bedding	21,300	TONS	163	181	$14.00	$15.55	$331,130	2, page 439
Geotextile	479,400	SF	163	181	$0.25	$0.28	$133,085	2, page 439
Riprap	75,360	TONS	163	181	$15.00	$16.66	$1,255,229	2, page 439
Reinforce Existing Levee								
Embankment	109,400	CY	163	181	$7.00	$7.77	$850,367	2, page 439
Bedding	95,200	TONS	163	181	$14.00	$15.55	$1,479,980	2, page 439
Geotextile	2,141,300	SF	163	181	$0.25	$0.28	$594,441	2, page 439
Riprap	336,700	TONS	163	181	$15.00	$16.66	$5,608,224	2, page 439
Railroad Trestle	31,200	SF				$100.00	$3,120,000	3
Bridge (Twin Cities Rd.)	42,000	SF				$100.00	$4,200,000	3
Purchase Gas Wells	JOB	LS						
SUBTOTAL GLANVILLE TRACT							$26,069,251	
III. McCORMACK-WILLIAMSON TRACT								
Land Acquisition	1,630	AC				$3,000.00	$4,890,000	1
Remove Existing Levee (Northeastern Boundary)								
Embankment	96,000	CY	163	181	$4.00	$4.44	$426,405	2, page 439

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Table 4
Estimated Capital Costs
Improved Through Delta Conveyance - Hood Intake Alternative

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX APR. 91	USBR INDEX OCT. 96	UNIT COST APR. 91	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Riprap	3,400	TONS	163	181	$7.50	$8.33	$28,316	2, page 439
Remove Existing Levee (Northern Boundary)								
Embankment	48,000	CY	163	181	$4.00	$4.44	$213,202	2, page 439
Riprap	1,700	TONS	163	181	$7.50	$8.33	$14,158	2, page 439
Remove Existing Levee (Southern Boundary)								
Embankment	96,000	CY	163	181	$7.00	$7.77	$746,209	2, page 439
Riprap	3,400	TONS	163	181	$7.50	$8.33	$28,316	2, page 439
SUBTOTAL McCORMACK-WILLIAMSON TRACT							$6,346,606	
IV. NEW HOPE TRACT								
Land Acquisition	3,800	AC				$3,000.00	$11,400,000	1
New Levee								
Embankment	1,273,800	CY	163	181	$7.00	$7.77	$9,901,255	2, page 439
Foundation	880,400	CY	163	181	$9.80	$10.88	$9,580,696	2, page 437
Bedding	67,500	TONS	163	181	$14.00	$15.55	$1,049,356	2, page 439
Geotextile	1,518,100	SF	163	181	$0.25	$0.28	$421,436	2, page 439
Riprap	238,700	TONS	163	181	$15.00	$16.66	$3,975,893	2, page 439
Allowance for New Hope Landing Relocation	JOB	LS				$10,000,000.00	$10,000,000	3
Allowance for Wimpy's Marina Relocation	JOB	LS				$1,200,000.00	$1,200,000	3
Remove Existing Levee (Mokelumne River)								
Embankment	96,000	CY	163	181	$4.00	$4.44	$426,405	2, page 439
Riprap	3,400	TONS	163	181	$7.50	$8.33	$28,316	2, page 439
Remove Existing Levee (Beaver Slough)								
Embankment	96,000	CY	163	181	$4.00	$4.44	$426,405	2, page 439
Riprap	3,400	TONS	163	181	$7.50	$8.33	$28,316	2, page 439
Bridge (Walnut Grove Road)	84,000	SF				$100.00	$8,400,000	3
Rebuild New Hope Tract Levee								
Embankment	85,700	CY	163	181	$7.00	$7.77	$666,147	2, page 439
Bedding	74,600	TONS	163	181	$14.00	$15.55	$1,159,733	2, page 439
Geotextile	1,677,900	SF	163	181	$0.25	$0.28	$465,797	2, page 439
Riprap	263,800	TONS	163	181	$15.00	$16.66	$4,393,969	2, page 439
Relocated Irrigation Diversions and Drainage Pumps	JOB	LS				$3,800,000	$3,800,000	3
Seepage Interception Wells (Beaver Slough)	JOB	LS				$471,000	$471,000	3
Reinforce Existing Levee (Beaver Slough)								
Embankment	24,500	CY	163	181	$7.00	$7.77	$190,439	2, page 439
Bedding	21,300	TONS	163	181	$14.00	$15.55	$331,130	2, page 439
Geotextile	479,400	SF	163	181	$0.25	$0.28	$133,085	2, page 439
Riprap	75,400	TONS	163	181	$15.00	$16.66	$1,255,896	2, page 439
Reinforce Existing Levee (S. Mokelumne River)								
Embankment	67,800	CY	163	181	$7.00	$7.77	$527,010	2, page 439
Bedding	59,000	TONS	163	181	$14.00	$15.55	$917,215	2, page 439
Geotextile	1,326,400	SF	163	181	$0.25	$0.28	$368,218	2, page 439
Riprap	208,500	TONS	163	181	$15.00	$16.66	$3,472,868	2, page 439
SUBTOTAL NEW HOPE TRACT							$74,990,584	

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Table 4
Estimated Capital Costs
Improved Through Delta Conveyance - Hood Intake Alternative

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX APR. 91	USBR INDEX OCT. 96	UNIT COST APR. 91	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
V. CANAL RANCH TRACT WETLANDS								
Land Acquisition	5,850	AC				$3,000.00	$17,550,000	1
Remove Existing Levee (Beaver Slough)								
Embankment	96,000	CY	163	181	$4.00	$4.44	$426,405	2, page 439
Riprap	3,400	TONS	163	181	$7.50	$8.33	$28,316	2, page 439
Remove Existing Levee (Hog Slough)								
Embankment	96,000	CY	163	181	$4.00	$4.44	$426,405	2, page 439
Riprap	3,400	TONS	163	181	$7.50	$8.33	$28,316	2, page 439
Reinforce Existing Levee (Beaver Slough)								
Embankment	74,300	CY	163	181	$7.00	$7.77	$577,534	2, page 439
Bedding	64,700	TONS	163	181	$14.00	$15.55	$1,005,827	2, page 439
Geotextile	1,454,200	SF	163	181	$0.25	$0.28	$403,697	2, page 439
Riprap	228,600	TONS	163	181	$15.00	$16.66	$3,807,663	2, page 439
Reinforce Existing Levee (S. Mokelumne River)								
Embankment	53,900	CY	163	181	$7.00	$7.77	$418,965	2, page 439
Bedding	46,900	TONS	163	181	$14.00	$15.55	$729,108	2, page 439
Geotextile	1,054,700	SF	163	181	$0.25	$0.28	$292,792	2, page 439
Riprap	165,800	TONS	163	181	$15.00	$16.66	$2,761,638	2, page 439
Reinforce Existing Levee (Hog Slough)								
Embankment	57,200	CY	163	181	$7.00	$7.77	$444,616	2, page 439
Bedding	49,700	TONS	163	181	$14.00	$15.55	$772,637	2, page 439
Geotextile	1,118,600	SF	163	181	$0.25	$0.28	$310,532	2, page 439
Riprap	175,900	TONS	163	181	$15.00	$16.66	$2,929,868	2, page 439
Relocate Ultilities	JOB	LS						
SUBTOTAL CANAL RANCH TRACT WETLANDS							$32,914,318	
VI. BRACK TRACT WETLANDS								
Land Acquisition	6,600	AC				$3,000	$19,800,000	1
Remove Existing Levee (Hog Slough)								
Embankment	96,000	CY	163	181	$4.00	$4.44	$426,405	2, page 439
Riprap	3,400	TONS	163	181	$7.50	$8.33	$28,316	2, page 439
Remove Existing Levee (Sycamore Slough)								
Embankment	96,000	CY	163	181	$4.00	$4.44	$426,405	2, page 439
Riprap	3,400	TONS	163	181	$7.50	$8.33	$28,316	2, page 439
Reinforce Existing Levee (Hog Slough)								
Embankment	57,200	CY	163	181	$7.00	$7.77	$444,616	2, page 439
Bedding	49,700	TONS	163	181	$14.00	$15.55	$772,637	2, page 439
Geotextile	1,118,600	SF	163	181	$0.25	$0.28	$310,532	2, page 439
Riprap	175,900	TONS	163	181	$15.00	$16.66	$2,929,868	2, page 439
Reinforce Existing Levee (S. Mokelumne River)								
Embankment	45,700	CY	163	181	$7.00	$7.77	$355,226	2, page 439
Bedding	39,800	TONS	163	181	$14.00	$15.55	$618,731	2, page 439
Geotextile	844,900	SF	163	181	$0.25	$0.28	$234,550	2, page 439
Riprap	140,700	TONS	163	181	$15.00	$16.66	$2,343,561	2, page 439
Reinforce Existing Levee (Sycamore Slough)								

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Table 4
Estimated Capital Costs
Improved Through Delta Conveyance - Hood Intake Alternative

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX APR. 91	USBR INDEX OCT. 96	UNIT COST APR. 91	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Embankment	93,900	CY	163	181	$7.00	$7.77	$729,885	2, page 439
Bedding	81,700	TONS	163	181	$14.00	$15.55	$1,270,109	2, page 439
Geotextile	1,837,700	SF	163	181	$0.25	$0.28	$510,159	2, page 439
Riprap	288,900	TONS	163	181	$15.00	$16.66	$4,812,046	2, page 439
Relocate Utilities	JOB	LS						
SUBTOTAL BRACK TRACT WETLANDS							$36,041,363	
VII. STATEN ISLAND SETBACK CHANNEL								
Land Acquisition	315	AC				$3,000	$945,000	1
Remove Existing Levee (Northern Boundary)								
Embankment	192,000	CY	163	181	$4.00	$4.44	$852,810	2, page 439
Riprap	6,800	TONS	163	181	$7.50	$8.33	$56,632	2, page 439
Remove Existing Levee (Soutern Boundary)								
Embankment	192,000	CY	163	181	$4.00	$4.44	$852,810	2, page 439
Riprap	6,800	TONS	163	181	$7.50	$8.33	$56,632	2, page 439
New Levee								
Embankment	653,900	CY	163	181	$7.00	$7.77	$5,082,769	2, page 439
Bedding	15,700	TONS	163	181	$14.00	$15.55	$244,072	2, page 439
Geotextile	351,600	SF	163	181	$0.25	$0.28	$97,607	2, page 439
Riprap	55,300	TONS	163	181	$15.00	$16.66	$921,101	2, page 439
Foundation	278,700	CY	163	181	$9.80	$10.88	$3,032,872	2, page 437
Reinforce Existing Levee								
Embankment	18,800	CY	163	181	$7.00	$7.77	$146,133	2, page 439
Bedding	16,400	TONS	163	181	$14.00	$15.55	$254,955	2, page 439
Geotextile	367,600	SF	163	181	$0.25	$0.28	$102,048	2, page 439
Riprap	57,800	TONS	163	181	$15.00	$16.66	$962,742	2, page 439
Seepage Interception Wells	JOB	LS				$2,078,000	$2,078,000	3
SUBTOTAL STATEN ISLAND SETBACK CHANNEL							$15,686,182	
VIII. TERMINOUS TRACT SETBACK CHANNEL								
Land Acquisition	220	AC				$3,000	$660,000	1
Remove Existing Levee (Northern Boundary)								
Embankment	96,000	CY	163	181	$4.00	$4.44	$426,405	2, page 439
Riprap	3,400	TONS	163	181	$7.50	$8.33	$28,316	2, page 439
Remove Existing Levee (Southern Boundary)								
Embankment	96,000	CY	163	181	$4.00	$4.44	$426,405	2, page 439
Riprap	3,400	TONS	163	181	$7.50	$8.33	$28,316	2, page 439
New Levee								
Embankment	772,800	CY	163	181	$7.00	$7.77	$6,006,979	2, page 439
Bedding	18,600	TONS	163	181	$14.00	$15.55	$289,156	2, page 439

Table 4
Estimated Capital Costs
Improved Through Delta Conveyance - Hood Intake Alternative

DESCRIPTION	QUANTITY	UNIT*	USBR INDEX APR. 91	USBR INDEX OCT. 96	UNIT COST APR. 91	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Geotextile	415,600	SF	163	181	$0.25	$0.28	$115,374	2, page 439
Riprap	65,400	TONS	163	181	$15.00	$16.66	$1,089,331	2, page 439
Foundation	329,400	CY	163	181	$9.80	$10.88	$3,584,600	2, page 437
Reinforce Existing Levee								
Embankment	22,900	CY	163	181	$7.00	$7.77	$178,002	2, page 439
Bedding	19,900	TONS	163	181	$14.00	$15.55	$309,366	2, page 439
Geotextile	447,500	SF	163	181	$0.25	$0.28	$124,229	2, page 439
Riprap	70,400	TONS	163	181	$15.00	$16.66	$1,172,613	2, page 439
Seepage Interception Wells	JOB	LS				$1,806,000	$1,806,000	3
Relocated Irrigation Diversion and Drainage.Pumps	JOB	LS				$315,000	$315,000	3
SUBTOTAL TERMINOUS TRACT SETBACK CHANNEL							$16,560,091	
IX. BOULDIN ISLAND								
Land Acquisition	5,913	AC				$3,000.00	$17,739,000	1
Remove Existing Levee (S. Mokelumne River)								
Embankment	192,000	CY	163	181	$4.00	$4.44	$852,810	2, page 439
Riprap	6,800	TONS	163	181	$7.50	$8.33	$56,632	2, page 439
Remove Existing Levee (San Joaquin River)								
Embankment	192,000	CY	163	181	$4.00	$4.44	$852,810	2, page 439
Riprap	6,800	TONS	163	181	$7.50	$8.33	$56,632	2, page 439
Reinforce Existing Levee								
Embankment	350,900	CY	163	181	$7.00	$7.77	$2,727,548	2, page 439
Bedding	305,300	TONS	163	181	$14.00	$15.55	$4,746,198	2, page 439
Geotextile	6,871,400	SF	163	181	$0.25	$0.28	$1,907,551	2, page 439
Riprap	1,080,200	TONS	163	181	$15.00	$16.66	$17,992,288	2, page 439
Elevated Roadway								
Embankment	2,493,400	CY	163	181	$7.00	$7.77	$19,381,213	2, page 439
Bedding	156,200	TONS	163	181	$14.00	$15.55	$2,428,287	2, page 439
Geotextile	3,515,600	SF	163	181	$0.25	$0.28	$975,956	2, page 439
Riprap	552,700	TONS	163	181	$15.00	$16.66	$9,206,015	2, page 439
Foundation	1,188,000	CY	163	181	$9.80	$10.88	$12,928,064	2, page 437
Aggregate Base	14,600	TONS				$19.15	$279,590	4, item v-d
Asphalt Concrete	6,600	TONS				$58.92	$388,872	4, item v-e
Bridge	84,000	SF				$100.00	$8,400,000	3
Seepage Interceptor Wells	JOB	LS				$2,650,000	$2,650,000	3
SUBTOTAL BOULDIN ISLAND							$103,569,467	
SOUTH DELTA								
I. PALM TRACT								
Land Acquisition	1,047	AC				$3,000	$3,141,000	1

Table 4
Estimated Capital Costs
Improved Through Delta Conveyance - Hood Intake Alternative

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX APR. 91	USBR INDEX OCT. 96	UNIT COST APR. 91	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Remove Existing Levee (Northern Boundary)								
Embankment	144,000	CY	163	181	$4.00	$4.44	$639,607	2, page 439
Riprap	5,100	TONS	163	181	$7.50	$8.33	$42,474	2, page 439
Remove Existing Levee (Southern Boundary)								
Embankment	144,000	CY	163	181	$4.00	$4.44	$639,607	2, page 439
Riprap	5,100	TONS	163	181	$7.50	$8.33	$42,474	2, page 439
New Levee (Western Boundary)								
Embankment	1,461,500	CY	163	181	$7.00	$7.77	$11,360,248	2, page 439
Bedding	42,600	TONS	163	181	$14.00	$15.55	$662,260	2, page 439
Geotextile	958,800	SF	163	181	$0.25	$0.28	$266,170	2, page 439
Riprap	150,700	TONS	163	181	$15.00	$16.66	$2,510,126	2, page 439
Foundation	688,000	CY	163	181	$9.80	$10.88	$7,486,960	3
Reinforce Existing Levee								
Embankment	82,400	CY	163	181	$7.00	$7.77	$640,496	2, page 439
Bedding	71,700	TONS	163	181	$14.00	$15.55	$1,114,649	2, page 439
Geotextile	1,614,000	SF	163	181	$0.25	$0.28	$448,058	2, page 439
Riprap	253,700	TONS	163	181	$15.00	$16.66	$4,225,739	2, page 439
Relocated Irrigation Diversions and Drainage Pumps	JOB	LS				$1,047,000.00	$1,047,000.00	3
Railroad Trestle	60,000	SF				$100.00	$6,000,000	3
SUBTOTAL PALM TRACT							$40,266,869	
II. ORWOOD TRACT								
Land Acquisition	690	AC				$3,000.00	$2,070,000	1
New Levee (Western Boundary)								
Embankment	999,500	CY	163	181	$7.00	$7.77	$7,769,120	2, page 439
Bedding	27,000	TONS	163	181	$14.00	$15.55	$419,742	2, page 439
Geotextile	607,200	SF	163	181	$0.25	$0.28	$168,563	2, page 439
Riprap	95,500	TONS	163	181	$15.00	$16.66	$1,590,690	2, page 439
Foundation	451,000	CY	163	181	$9.80	$10.88	$4,907,876	3
Reinforce Existing Levee								
Embankment	43,300	CY	163	181	$7.00	$7.77	$336,571	2, page 439
Bedding	37,600	TONS	163	181	$14.00	$15.55	$584,530	2, page 439
Geotextile	846,900	SF	163	181	$0.25	$0.28	$235,106	2, page 439
Riprap	133,100	TONS	163	181	$15.00	$16.66	$2,216,972	2, page 439
Remove Existing Levee (Southern Boundary)								
Embankment	124,800	CY	163	181	$4.00	$4.44	$554,326	2, page 439
Riprap	4,420	TONS	163	181	$7.50	$8.33	$36,811	2, page 439
Remove Existing Levee (N.E. Corner)								
Embankment	144,000	CY	163	181	$4.00	$4.44	$639,607	2, page 439
Riprap	5,100	TONS	163	181	$7.50	$8.33	$42,474	2, page 439
Relocated Irrigation Diversions and Drainage Pumps	JOB	LS				$690,000.00	$690,000.00	3
Raise Mokelumne Aqueduct	JOB	LS				$4,078,000.00	$4,078,000.00	3
SUBTOTAL ORWOOD TRACT							$26,340,389	

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Table 4
Estimated Capital Costs
Improved Through Delta Conveyance - Hood Intake Alternative

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX APR. 91	USBR INDEX OCT. 96	UNIT COST APR. 91	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
III. BYRON TRACT								
Land Acquisition	1,102	AC				$3,000.00	$3,306,000	1
Remove Existing Levee (Northern Boundary)								
Embankment	192,000	CY	163	181	$4.00	$4.44	$852,810	2, page 439
Riprap	6,800	TONS	163	181	$7.50	$8.33	$56,632	2, page 439
Remove Existing Levee (North of Hwy. 4)								
Embankment	48,000	CY	163	181	$4.00	$4.44	$213,202	2, page 439
Riprap	1,700	TONS	163	181	$7.50	$8.33	$14,158	2, page 439
New Levee								
Embankment	965,100	CY	163	181	$7.00	$7.77	$7,501,728	2, page 439
Bedding	36,200	TONS	163	181	$14.00	$15.55	$562,766	2, page 439
Geotextile	815,000	SF	163	181	$0.25	$0.28	$226,250	2, page 439
Riprap	128,100	TONS	163	181	$15.00	$16.66	$2,133,690	2, page 439
Foundation	523,600	CY	163	181	$9.80	$10.88	$5,697,924	3
Reinforce Existing Levee								
Embankment	46,500	CY	163	181	$7.00	$7.77	$361,445	2, page 439
Bedding	40,500	TONS	163	181	$14.00	$15.55	$629,613	2, page 439
Geotextile	910,900	SF	163	181	$0.25	$0.28	$252,873	2, page 439
Riprap	143,200	TONS	163	181	$15.00	$16.66	$2,385,202	2, page 439
Elevated Roadway								
Embankment	334,400	CY	163	181	$7.00	$7.77	$2,599,293	2, page 439
Bedding	11,400	TONS	163	181	$14.00	$15.55	$177,225	2, page 439
Geotextile	255,700	SF	163	181	$0.25	$0.28	$70,984	2, page 439
Riprap	40,200	TONS	163	181	$15.00	$16.66	$669,589	2, page 439
Foundation	166,400	CY	163	181	$9.80	$10.88	$1,810,800	3
Aggregate Base	2,112	TONS				$19.15	$40,445	4, item v-d
Asphalt Concrete	960	TONS				$58.92	$56,563	4, item v-e
Bridge	84,000	SF				$100.00	$8,400,000	3
Relocated Irrigation Diversions and Drainage Pumps	JOB	LS				$1,102,000	$1,102,000	3
SUBTOTAL BYRON TRACT							$39,121,192	
IV. VICTORIA ISLAND								
Land Acquisition	546	AC				$3,000.00	$1,638,000	1
Remove Existing Levee (Northern Boundary)								
Embankment	48,000	CY	163	181	$4.00	$4.44	$213,202	2, page 439
Riprap	1,700	TONS	163	181	$7.50	$8.33	$14,158	2, page 439
Remove Existing Levee (Old River and CCFB)								
Embankment	48,000	CY	163	181	$4.00	$4.44	$213,202	2, page 439
Riprap	1,700	TONS	163	181	$7.50	$8.33	$14,158	2, page 439
New Levee								
Embankment	1,281,300	CY	163	181	$7.00	$7.77	$9,959,553	2, page 439
Bedding	44,000	TONS	163	181	$14.00	$15.55	$684,025	2, page 439
Geotextile	990,800	SF	163	181	$0.25	$0.28	$275,053	2, page 439
Riprap	155,800	TONS	163	181	$15.00	$16.66	$2,595,074	2, page 439

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Table 4
Estimated Capital Costs
Improved Through Delta Conveyance - Hood Intake Alternative

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX APR. 91	USBR INDEX OCT. 96	UNIT COST APR. 91	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Foundation	661,400	CY	163	181	$9.80	$10.88	$7,197,493	3
Reinforce Existing Levee								
Embankment	53,100	CY	163	181	$7.00	$7.77	$412,747	2, page 439
Bedding	46,200	TONS	163	181	$14.00	$15.55	$718,226	2, page 439
Geotextile	1,038,700	SF	163	181	$0.25	$0.28	$288,351	2, page 439
Riprap	163,300	TONS	163	181	$15.00	$16.66	$2,719,997	2, page 439
Relocated Irrigation Diversions and Drainage Pumps	JOB	LS				$546,000	$546,000	3
SUBTOTAL VICTORIA ISLAND							$27,489,238	
V. CLIFTON COURT FOREBAY AND VICINITY								
New Intake at Northern End Of CCFB	JOB	LS				$13,640,000	$13,640,000	5
Fish Screens at Skinner Fish Facility	10,400	CFS				$10,000	$104,000,000	3
Interconnection between CCFB and DMC	JOB	LS				$20,346,000	$20,346,000	3
Fish Screens at Tracy PP	4,500	CFS				$10,000	$45,000,000	3
SUBTOTAL CLIFTON COURT FOREBAY AND VICINITY							$182,986,000	
SUBTOTAL SOUTH DELTA							$316,203,688	
SUBTOTAL NORTH DELTA							$569,605,359	
SUBTOTAL FOR IMPROVED THROUGH DELTA CONVEYANCE - HOOD INTAKE ALTERNATIVE							$885,800,000	
CONTINGENCIES @ 20%							$177,200,000	
ESTIMATED CONSTRUCTION COST FOR IMPROVED THROUGH DELTA CONVEYANCE - HOOD INTAKE ALTERNATIVE							$1,063,000,000	
ENG., LEGAL, AND ADM. @ 35%							$372,100,000	
ESTIMATED CAPITAL COST FOR IMPROVED THROUGH DELTA CONVEYANCE - HOOD INTAKE ALTERNATIVE							$1,435,100,000	
ESTIMATED CAPITAL COST RANGE FOR IMPROVED THROUGH DELTA CONVEYANCE - HOOD INTAKE ALTERNATIVE								
LOW (-10%)							$1,292,000,000	
HIGH (+25%)							$1,794,000,000	

Footnotes:

[a]CY=cubic yard; LB=pound; EA=each; LS=lump sum; LF=linear foot; SF=square foot; TON=ton; MI=mile; AC=acre

Cost Reference:

1. U.S. Bureau of Reclamation, Land Resources Branch, Graham McMullen, February 1997
2. California Department of Water Resources, *North Delta Program Draft EIR, EIS, November 1990*
3. Costs developed by Bookman-Edmonston Engineering, Inc.
4. California Department of Water Resources, Los Banos Grandes Facilities Report, Appendix A: Designs and Cost Estimates, December 1990
5. California Department of Water Resources, ISDP Cost Estimate: Proposed Clifton Court Forebay Northern Intake Structure, October 1993

D-008953

Table 5
Estimated Capital Costs
Improved Through Delta Conveyance - Tyler Island Alternative

DESCRIPTION	QUANTITY	UNIT*	USBR INDEX APR. 91	USBR INDEX OCT. 96	UNIT COST APR. 91	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
NORTH DELTA								
I. McCORMACK AND WILLIAMSON TRACT								
Land Acquisition	1,630	AC				$3,000	$4,890,000	1
Remove Existing Levee (Northeastern Boundary)								
Embankment	96,000	CY	163	181	$4.00	$4.44	$426,405	2, page 439
Riprap	3,400	TONS	163	181	$7.50	$8.33	$28,316	2, page 439
Remove Existing Levee (Dead Horse Cut)								
Embankment	48,000	CY	163	181	$4.00	$4.44	$213,202	2, page 439
Riprap	1,700	TONS	163	181	$7.50	$8.33	$14,158	2, page 439
SUBTOTAL McCORMACK AND WILLIAMSON TRACT							$5,572,081	
II. DEAD HORSE ISLAND								
Land Acquisition	225	AC				$3,000.00	$675,000	1
Remove Existing Levee (Dead Horse Cut)								
Embankment	48,000	CY	163	181	$4.00	$4.44	$213,202	2, page 439
Riprap	1,700	TONS	163	181	$7.50	$8.33	$14,158	2, page 439
Remove Existing Levee (Snodgrass Slough)								
Embankment	48,000	CY	163	181	$4.00	$4.44	$213,202	2, page 439
Riprap	1,700	TONS	163	181	$7.50	$8.33	$14,158	2, page 439
Reinforce Existing Levee along Snodgrass Slough								
Embankment	31,100	CY	163	181	$7.00	$7.77	$241,740	2, page 439
Bedding	27,000	TONS	163	181	$14.00	$15.55	$419,742	2, page 439
Geotextile	607,300	SF	163	181	$0.25	$0.28	$168,591	2, page 439
Riprap	95,500	TONS	163	181	$15.00	$16.66	$1,590,690	2, page 439
Reinforce Existing Levee along N. Mokelumne River								
Embankment	16,300	CY	163	181	$7.00	$7.77	$126,700	2, page 439
Bedding	14,200	TONS	163	181	$14.00	$15.55	$220,753	2, page 439
Geotextile	319,600	SF	163	181	$0.25	$0.28	$88,723	2, page 439
Riprap	50,240	TONS	163	181	$15.00	$16.66	$836,820	2, page 439
SUBTOTAL DEAD HORSE ISLAND							$4,823,481	
III. ANDRUS ISLAND								
Land Acquisition	125	AC				$3,000.00	$375,000	1
Remove Existing Levee (Sacramento River)								
Embankment	24,000	CY	163	181	$4.00	$4.44	$106,601	2, page 439
Riprap	850	TONS	163	181	$7.50	$8.33	$7,079	2, page 439
Remove Existing Levee (Georgiana Slough)								
Embankment	48,000	CY	163	181	$4.00	$4.44	$213,202	2, page 439
Riprap	1,700	TONS	163	181	$7.50	$8.33	$14,158	2, page 439
Reinforce Existing Levee (Georgiana Slough)								
Embankment	9,000	CY	163	181	$7.00	$7.77	$69,957	2, page 439
Bedding	7,900	TONS	163	181	$14.00	$15.55	$122,813	2, page 439
Geotextile	175,800	SF	163	181	$0.25	$0.28	$48,803	2, page 439
Riprap	27,700	TONS	163	181	$15.00	$16.66	$461,383	2, page 439

D—008954

Table 5
Estimated Capital Costs
Improved Through Delta Conveyance - Tyler Island Alternative

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX APR. 91	USBR INDEX OCT. 96	UNIT COST APR. 91	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Elevated Roadway								
Embankment	302,000	CY	163	181	$7.00	$7.77	$2,347,448	2, page 439
Bedding	12,800	TONS	163	181	$14.00	$15.55	$198,989	2, page 439
Geotextile	287,700	SF	163	181	$0.25	$0.28	$79,868	2, page 439
Riprap	45,300	TONS	163	181	$15.00	$16.66	$754,537	2, page 439
Foundation	169,200	CY	163	181	$9.80	$10.88	$1,841,270	3
Aggregate Base	2,380	TONS				$19.15	$45,577	4, item v-d
Asphalt Concrete	1,080	TONS				$58.92	$63,634	4, item v-e
New Levee								
Embankment	44,600	CY	163	181	$7.00	$7.77	$346,676	2, page 439
Bedding	2,500	TONS	163	181	$14.00	$15.55	$38,865	2, page 439
Geotextile	56,000	SF	163	181	$0.25	$0.28	$15,546	2, page 439
Riprap	8,800	TONS	163	181	$15.00	$16.66	$146,577	2, page 439
Foundation	27,800	CY	163	181	$9.80	$10.88	$302,525	3
Bridge (Walnut Grove Road)	29,400	SF				$100.00	$2,940,000	
Silt Control Gradient	JOB	LS				$2,108,102	$2,108,102	
SUBTOTAL ANDRUS ISLAND							$12,648,611	
IV. TYLER ISLAND								
Land Acquisition	8,818	AC				$3,000.00	$26,454,000	1
Remove Existing Levee (Snodgrass Slough)								
Embankment	48,000	CY	163	181	$4.00	$4.44	$213,202	2, page 439
Riprap	1,700	TONS	163	181	$7.50	$8.33	$14,158	2, page 439
New Levee								
Embankment	280,400	CY	163	181	$7.00	$7.77	$2,179,551	2, page 439
Bedding	15,700	TONS	163	181	$14.00	$15.55	$244,072	2, page 439
Geotextile	351,600	SF	163	181	$0.25	$0.28	$97,607	2, page 439
Riprap	55,300	TONS	163	181	$15.00	$16.66	$921,101	2, page 439
Foundation	174,600	CY	163	181	$9.80	$10.88	$1,900,034	3
Elevated Road								
Embankment	42,000	CY	163	181	$7.00	$7.77	$326,466	2, page 439
Bedding	1,800	TONS	163	181	$14.00	$15.55	$27,983	2, page 439
Geotextile	40,000	SF	163	181	$0.25	$0.28	$11,104	2, page 439
Riprap	6,300	TONS	163	181	$15.00	$16.66	$104,936	2, page 439
Foundation	23,500	CY	163	181	$9.80	$10.88	$255,732	3
Aggregate Base	330	TONS				$19.15	$6,320	4, item v-d
Asphalt Concrete	150	TONS				$58.92	$8,838	4, item v-e
Bridge (Thorton-Walnut Grove Road)	42,000	SF				$100.00	$4,200,000	3
Weir w/ Bridge (Tyler Island Road)	JOB	LS				$2,520,000.00	$2,520,000.00	3
Reinforce Existing Levee (Georgiana Slough)								
Embankment	256,300	CY	163	181	$7.00	$7.77	$1,992,221	2, page 439
Bedding	223,000	TONS	163	181	$14.00	$15.55	$3,466,761	2, page 439
Geotextile	5,017,800	SF	163	181	$0.25	$0.28	$1,392,978	2, page 439
Riprap	788,800	TONS	163	181	$15.00	$16.66	$13,138,601	2, page 439
Reinforce Existing Levee Along N. Mokelumne River								

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Table 5
Estimated Capital Costs
Improved Through Delta Conveyance - Tyler Island Alternative

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX APR. 91	USBR INDEX OCT. 96	UNIT COST APR. 91	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Embankment	202,400	CY	163	181	$7.00	$7.77	$1,573,256	2, page 439
Bedding	176,100	TONS	163	181	$14.00	$15.55	$2,737,653	2, page 439
Geotextile	3,963,100	SF	163	181	$0.25	$0.28	$1,100,186	2, page 439
Riprap	623,000	TONS	163	181	$15.00	$16.66	$10,376,963	2, page 439
Remove Existing Levee (Mokelumne River)								
Embankment	96,000	CY	163	181	$4.00	$4.44	$426,405	2, page 439
Riprap	3,400	TONS	163	181	$7.50	$8.33	$28,316	2, page 439
SUBTOTAL TYLER ISLAND							$75,718,444	
V. BOULDIN ISLAND								
Land Acquisition	5,913	AC				$3,000.00	$17,739,000	1
Remove Existing Levee (Mokelumne River)								
Embankment	96,000	CY	163	181	$4.00	$4.44	$426,405	2, page 439
Riprap	3,400	TONS	163	181	$7.50	$8.33	$28,316	2, page 439
Remove Existing Levee (San Joaquin River)								
Embankment	144,000	CY	163	181	$4.00	$4.44	$639,607	2, page 439
Riprap	5,100	TONS	163	181	$7.50	$8.33	$42,474	2, page 439
Reinforce Existing Levee								
Embankment	363,200	CY	163	181	$7.00	$7.77	$2,823,156	2, page 439
Bedding	316,000	TONS	163	181	$14.00	$15.55	$4,912,540	2, page 439
Geotextile	7,111,100	SF	163	181	$0.25	$0.28	$1,974,094	2, page 439
Riprap	1,117,900	TONS	163	181	$15.00	$16.66	$18,620,236	2, page 439
Elevated Roadway								
Embankment	2,493,400	CY	163	181	$7.00	$7.77	$19,381,213	2, page 439
Bedding	156,200	TONS	163	181	$14.00	$15.55	$2,428,287	2, page 439
Geotextile	3,515,600	SF	163	181	$0.25	$0.28	$975,956	2, page 439
Riprap	552,700	TONS	163	181	$15.00	$16.66	$9,206,015	2, page 439
Foundation	1,188,000	CY	163	181	$9.80	$10.88	$12,928,064	3
Aggregate Base	14,600	TONS				$19.15	$279,590	4, item v-d
Asphalt Concrete	6,600	TONS				$58.92	$388,872	4, item v-e
Bridge	84,000	SF				$100.00	$8,400,000	3
Seepage Interception Wells	JOB	LS				$3,560,000.00	$3,560,000	
SUBTOTAL BOULDIN ISLAND							$104,753,826	
SUBTOTAL NORTH DELTA							$203,516,443	
SOUTH DELTA								
I. PALM TRACT								
Land Acquisition	1,047	AC				$3,000	$3,141,000	1
Remove Existing Levee (Northern Boundary)								
Embankment	144,000	CY	163	181	$4.00	$4.44	$639,607	2, page 439
Riprap	5,100	TONS	163	181	$7.50	$8.33	$42,474	2, page 439
Remove Existing Levee (Southern Boundary)								
Embankment	144,000	CY	163	181	$4.00	$4.44	$639,607	2, page 439

Table 5
Estimated Capital Costs
Improved Through Delta Conveyance - Tyler Island Alternative

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX APR. 91	USBR INDEX OCT. 96	UNIT COST APR. 91	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Riprap	5,100	TONS	163	181	$7.50	$8.33	$42,474	2, page 439
New Levee (Western Boundary)								
Embankment	1,461,500	CY	163	181	$7.00	$7.77	$11,360,248	2, page 439
Bedding	42,600	TONS	163	181	$14.00	$15.55	$662,260	2, page 439
Geotextile	958,800	SF	163	181	$0.25	$0.28	$266,170	2, page 439
Riprap	150,700	TONS	163	181	$15.00	$16.66	$2,510,126	2, page 439
Foundation	688,000	CY	163	181	$9.80	$10.88	$7,486,960	3
Reinforce Existing Levee								
Embankment	82,400	CY	163	181	$7.00	$7.77	$640,496	2, page 439
Bedding	71,700	TONS	163	181	$14.00	$15.55	$1,114,649	2, page 439
Geotextile	1,614,000	SF	163	181	$0.25	$0.28	$448,058	2, page 439
Riprap	253,700	TONS	163	181	$15.00	$16.66	$4,225,739	2, page 439
Relocated Irrigation Diversions and Drainage Pumps	JOB	LS				$1,047,000.00	$1,047,000.00	3
Railroad Trestle	60,000	SF				$100.00	$6,000,000	3
SUBTOTAL PALM TRACT							$40,266,869	
II. ORWOOD TRACT								
Land Acquisition	690	AC				$3,000.00	$2,070,000	1
New Levee (Western Boundary)								
Embankment	999,500	CY	163	181	$7.00	$7.77	$7,769,120	2, page 439
Bedding	27,000	TONS	163	181	$14.00	$15.55	$419,742	2, page 439
Geotextile	607,200	SF	163	181	$0.25	$0.28	$168,563	2, page 439
Riprap	95,500	TONS	163	181	$15.00	$16.66	$1,590,690	2, page 439
Foundation	451,000	CY	163	181	$9.80	$10.88	$4,907,876	3
Reinforce Existing Levee								
Embankment	43,300	CY	163	181	$7.00	$7.77	$336,571	2, page 439
Bedding	37,600	TONS	163	181	$14.00	$15.55	$584,530	2, page 439
Geotextile	846,900	SF	163	181	$0.25	$0.28	$235,106	2, page 439
Riprap	133,100	TONS	163	181	$15.00	$16.66	$2,216,972	2, page 439
Remove Existing Levee (Southern Boundary)								
Embankment	124,800	CY	163	181	$4.00	$4.44	$554,326	2, page 439
Riprap	4,420	TONS	163	181	$7.50	$8.33	$36,811	2, page 439
Remove Existing Levee (N.E. Corner)								
Embankment	144,000	CY	163	181	$4.00	$4.44	$639,607	2, page 439
Riprap	5,100	TONS	163	181	$7.50	$8.33	$42,474	2, page 439
Relocated Irrigation Diversions and Drainage Pumps	JOB	LS				$690,000.00	$690,000.00	3
Raise Mokelumne Aqueduct	JOB	LS				$4,078,000.00	$4,078,000.00	3
SUBTOTAL ORWOOD TRACT							$26,340,389	
III. BYRON TRACT								
Land Acquisition	1,102	AC				$3,000.00	$3,306,000	1
Remove Existing Levee (Northern Boundary)								
Embankment	192,000	CY	163	181	$4.00	$4.44	$852,810	2, page 439
Riprap	6,800	TONS	163	181	$7.50	$8.33	$56,632	2, page 439
Remove Existing Levee (North of Hwy. 4)								

Table 5
Estimated Capital Costs
Improved Through Delta Conveyance - Tyler Island Alternative

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX APR. 91	USBR INDEX OCT. 96	UNIT COST APR. 91	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Embankment	48,000	CY	163	181	$4.00	$4.44	$213,202	2, page 439
Riprap	1,700	TONS	163	181	$7.50	$8.33	$14,158	2, page 439
New Levee								
Embankment	965,100	CY	163	181	$7.00	$7.77	$7,501,728	2, page 439
Bedding	36,200	TONS	163	181	$14.00	$15.55	$562,766	2, page 439
Geotextile	815,000	SF	163	181	$0.25	$0.28	$226,250	2, page 439
Riprap	128,100	TONS	163	181	$15.00	$16.66	$2,133,690	2, page 439
Foundation	523,600	CY	163	181	$9.80	$10.88	$5,697,924	3
Reinforce Existing Levee								
Embankment	46,500	CY	163	181	$7.00	$7.77	$361,445	2, page 439
Bedding	40,500	TONS	163	181	$14.00	$15.55	$629,613	2, page 439
Geotextile	910,900	SF	163	181	$0.25	$0.28	$252,873	2, page 439
Riprap	143,200	TONS	163	181	$15.00	$16.66	$2,385,202	2, page 439
Elevated Roadway								
Embankment	334,400	CY	163	181	$7.00	$7.77	$2,599,293	2, page 439
Bedding	11,400	TONS	163	181	$14.00	$15.55	$177,225	2, page 439
Geotextile	255,700	SF	163	181	$0.25	$0.28	$70,984	2, page 439
Riprap	40,200	TONS	163	181	$15.00	$16.66	$669,589	2, page 439
Foundation	166,400	CY	163	181	$9.80	$10.88	$1,810,800	3
Aggregate Base	2,112	TONS				$19.15	$40,445	4, item v-d
Asphalt Concrete	960	TONS				$58.92	$56,563	4, item v-e
Bridge	84,000	SF				$100.00	$8,400,000	3
Relocated Irrigation Diversions and Drainage Pumps	JOB	LS				$1,102,000	$1,102,000	3
SUBTOTAL BYRON TRACT							$39,121,192	
IV. VICTORIA ISLAND								
Land Acquisition	546	AC				$3,000.00	$1,638,000	1
Remove Existing Levee (Northern Boundary)								
Embankment	48,000	CY	163	181	$4.00	$4.44	$213,202	2, page 439
Riprap	1,700	TONS	163	181	$7.50	$8.33	$14,158	2, page 439
Remove Existing Levee (Old River and CCFB)								
Embankment	48,000	CY	163	181	$4.00	$4.44	$213,202	2, page 439
Riprap	1,700	TONS	163	181	$7.50	$8.33	$14,158	2, page 439
New Levee								
Embankment	1,281,300	CY	163	181	$7.00	$7.77	$9,959,553	2, page 439
Bedding	44,000	TONS	163	181	$14.00	$15.55	$684,025	2, page 439
Geotextile	990,800	SF	163	181	$0.25	$0.28	$275,053	2, page 439
Riprap	155,800	TONS	163	181	$15.00	$16.66	$2,595,074	2, page 439
Foundation	661,400	CY	163	181	$9.80	$10.88	$7,197,493	3
Reinforce Existing Levee								
Embankment	53,100	CY	163	181	$7.00	$7.77	$412,747	2, page 439
Bedding	46,200	TONS	163	181	$14.00	$15.55	$718,226	2, page 439
Geotextile	1,038,700	SF	163	181	$0.25	$0.28	$288,351	2, page 439
Riprap	163,300	TONS	163	181	$15.00	$16.66	$2,719,997	2, page 439
Relocated Irrigation Diversions and Drainage Pumps	JOB	LS				$546,000	$546,000	3

Table 5
Estimated Capital Costs
Improved Through Delta Conveyance - Tyler Island Alternative

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX APR. 91	USBR INDEX OCT. 96	UNIT COST APR. 91	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
SUBTOTAL VICTORIA ISLAND							$27,489,238	
V. CLIFTON COURT FOREBAY AND VICINITY								
New Intake at Northern End Of CCFB	JOB	LS				$13,640,000	$13,640,000	5
Fish Screens at Skinner Fish Facility	10,400	CFS				$10,000	$104,000,000	3
Interconnection between CCFB and DMC	JOB	LS				$20,346,000	$20,346,000	3
Fish Screens at Tracy PP	4,500	CFS				$10,000	$45,000,000	3
SUBTOTAL CLIFTON COURT FOREBAY AND VICINITY							[illegible]	
SUBTOTAL SOUTH DELTA							$316,203,688	
SUBTOTAL NORTH DELTA							$203,516,443	
SUBTOTAL FOR THROUGH DELTA - TYLER ISLAND HABITAT							$519,700,000	
CONTINGENCIES @ 20%							$103,900,000	
ESTIMATED CONSTRUCTION COST FOR THROUGH DELTA - TYLER ISLAND HABITAT							$623,600,000	
ENG., LEGAL, AND ADM. @ 35%							$218,300,000	
ESTIMATED CAPITAL COST FOR THROUGH DELTA - TYLER ISLAND HABITAT							$841,900,000	
ESTIMATED CAPITAL COST RANGE FOR THROUGH DELTA - TYLER ISLAND HABITAT								
LOW (-10%)							$758,000,000	
HIGH (+25%)							$1,052,000,000	

Footnotes:
[a]CY=cubic yard; LB=pound; EA=each; LS=lump sum; LF=linear foot; SF=square foot; TON=ton; MI=mile; AC=acre

Cost Reference:
1. U.S. Bureau of Reclamation, Land Resources Branch, Graham McMullen, February 1997
2. California Department of Water Resources, *North Delta Program Draft EIR, EIS, November 1990*
3. Costs developed by Bookman-Edmonston Engineering, Inc.
4. California Department of Water Resources, Los Banos Grandes Facilities Report, Appendix A: Designs and Cost Estimates, December 1990
5. California Department of Water Resources, ISDP Cost Estimate: Proposed Clifton Court Forebay Northern Intake Structure, October 1993

Table 6
Summary of Estimated Capital Cost
Improved Through Delta Conveyance Project

Cost Item	Estimated Costs ($Million)
Hood Intake Alternative	
North/Central Delta Improvements	
Hood Intake Facility and Open Channel	257.4
Glanville Tract Setback Levee	26.1
McCormack-Williamson Tract Floodway and Habitat	6.3
New Hope Tract Setback Levee	75.0
Canal Ranch Tract Wetlands	32.9
Brack Tract Wetlands	36.1
Staten Island Setback Channel	15.7
Terminous Island Setback Channel	16.6
Bouldin Island Habitat and Conveyance	103.6
South Delta Improvements	
Palm Tract Setback Channel	40.3
Orwood Tract Setback Channel	26.3
Byron Tract Setback Channel	39.1
Victoria Island Setback Channel	27.5
Clifton Court Forebay and Vicinity Improvements	
New Intake From Victoria Island	13.6
New Fish Screens at Skinner Fish Facility	104.0
Interconnection between CCFB and DMC	20.3
New Fish Screens at Tracy Pumping Plant	45.0
SUBTOTAL	885.8
Contingencies (20%)	177.2
ESTIMATED CONSTRUCTION COST	1,063.0
Engineering, Legal, and Project Administration (35%)	372.1
ESTIMATED TOTAL CAPITAL COST	1,435.1
Capital Cost Range (minus 10% - plus 25%)	1,292 - 1,794
Tyler Island Alternative	
North/Central Delta Improvements	
Georgiana Slough/Andrus Island Setback Channel	12.7
Tyler Island Habitat and Conveyance	75.7
Bouldin Island Habitat and Conveyance	104.8
Mokelumne River Floodway	
McCormack-Williamson Tract Floodway	5.6
Dead Horse Island Floodway	4.8
South Delta Improvements	
Palm Tract Setback Channel	40.3
Orwood Tract Setback Channel	26.3
Byron Tract Setback Channel	39.1
Victoria Island Setback Channel	27.5
Clifton Court Forebay and Vicinity Improvements	
New Intake From Victoria Island	13.6
New Fish Screens at Skinner Fish Facility	104.0
Interconnection between CCFB and DMC	20.3
New Fish Screens at Tracy Pumping Plant	45.0
SUBTOTAL	519.7
Contingencies (20%)	103.9
ESTIMATED CONSTRUCTION COST	623.6
Engineering, Legal, and Project Administration (35%)	218.3
ESTIMATED TOTAL CAPITAL COST	841.9
Capital Cost Range (minus 10% - plus 25%)	758 - 1,052

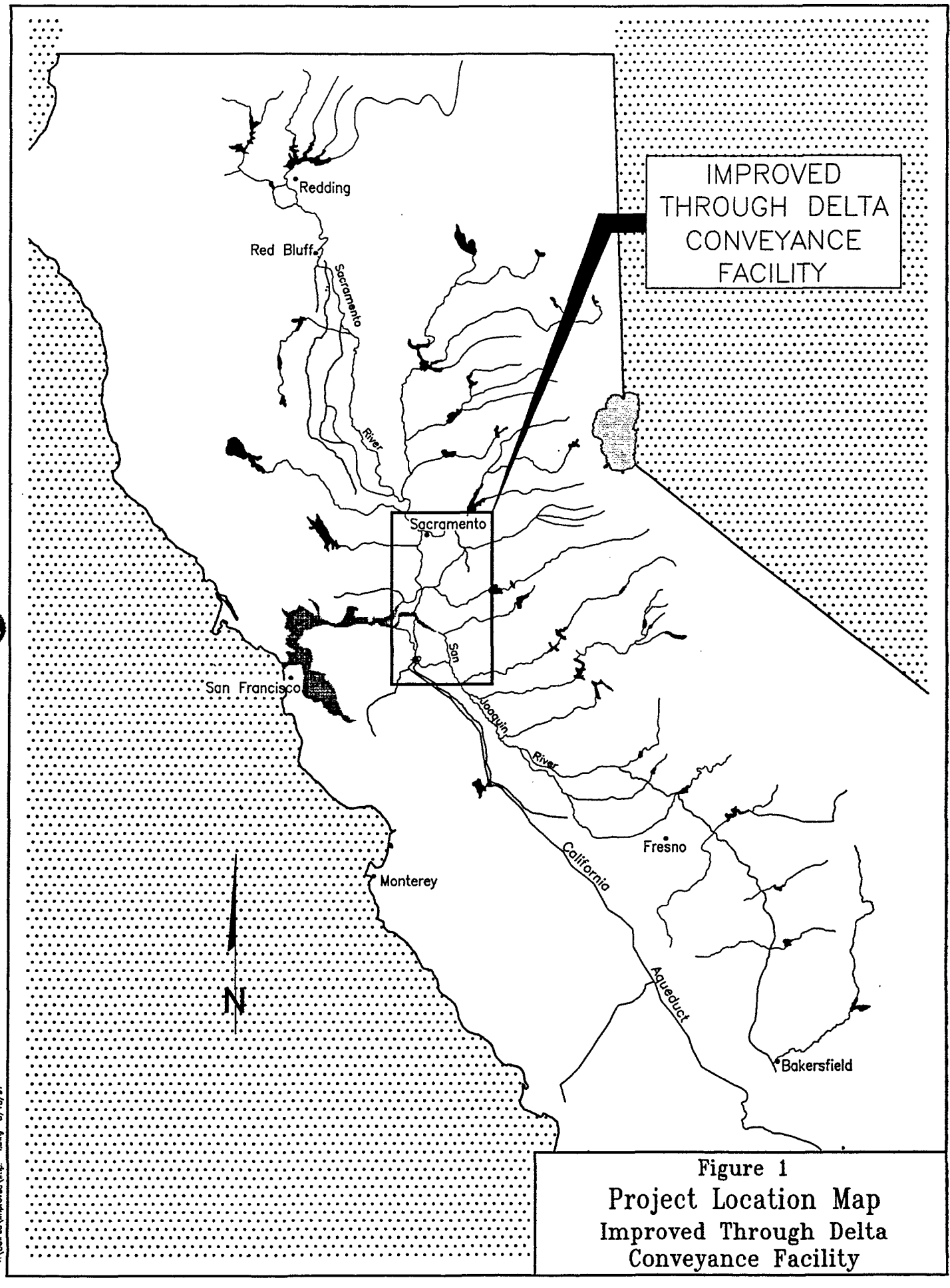

Figure 1
Project Location Map
Improved Through Delta
Conveyance Facility

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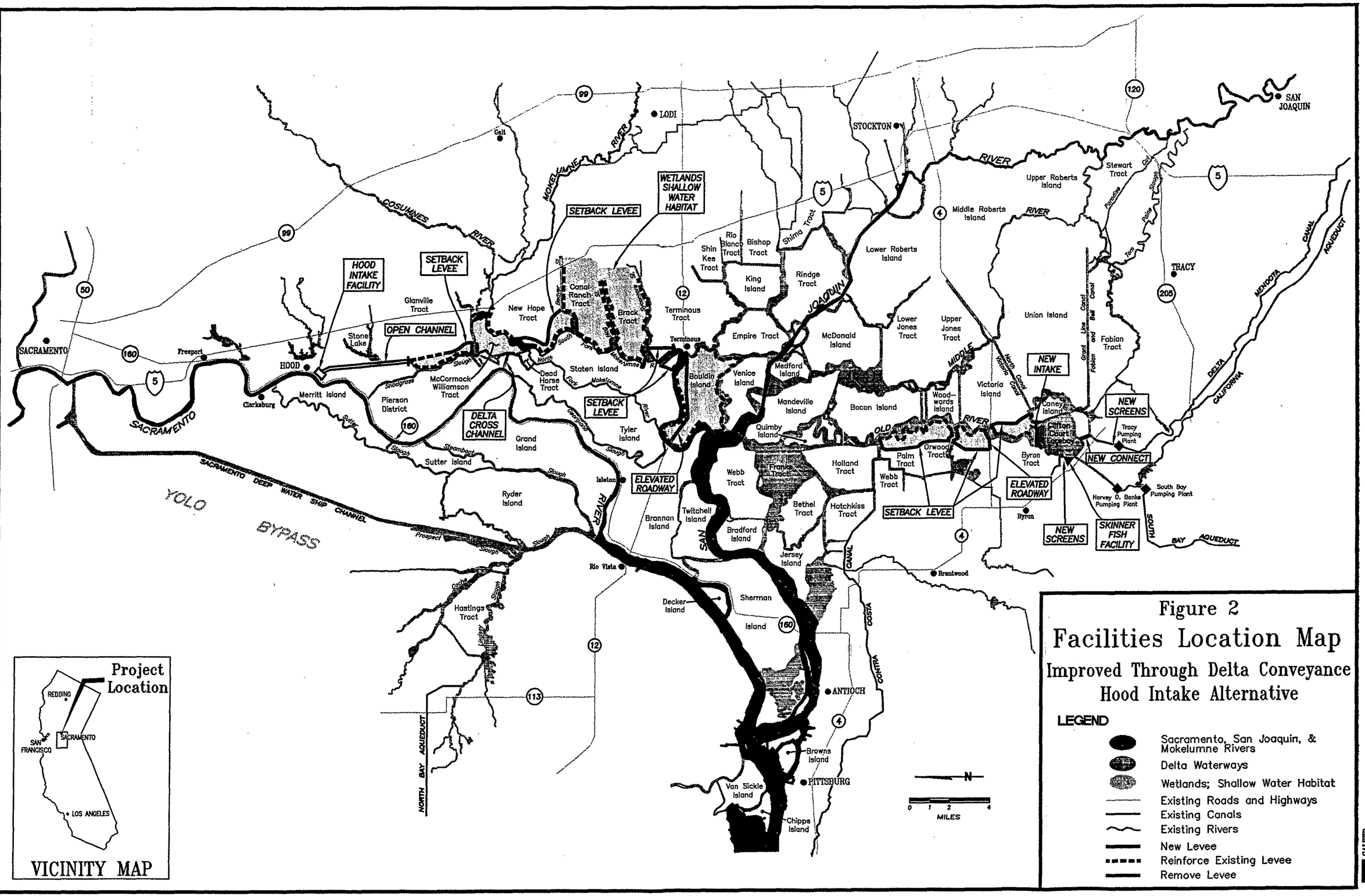

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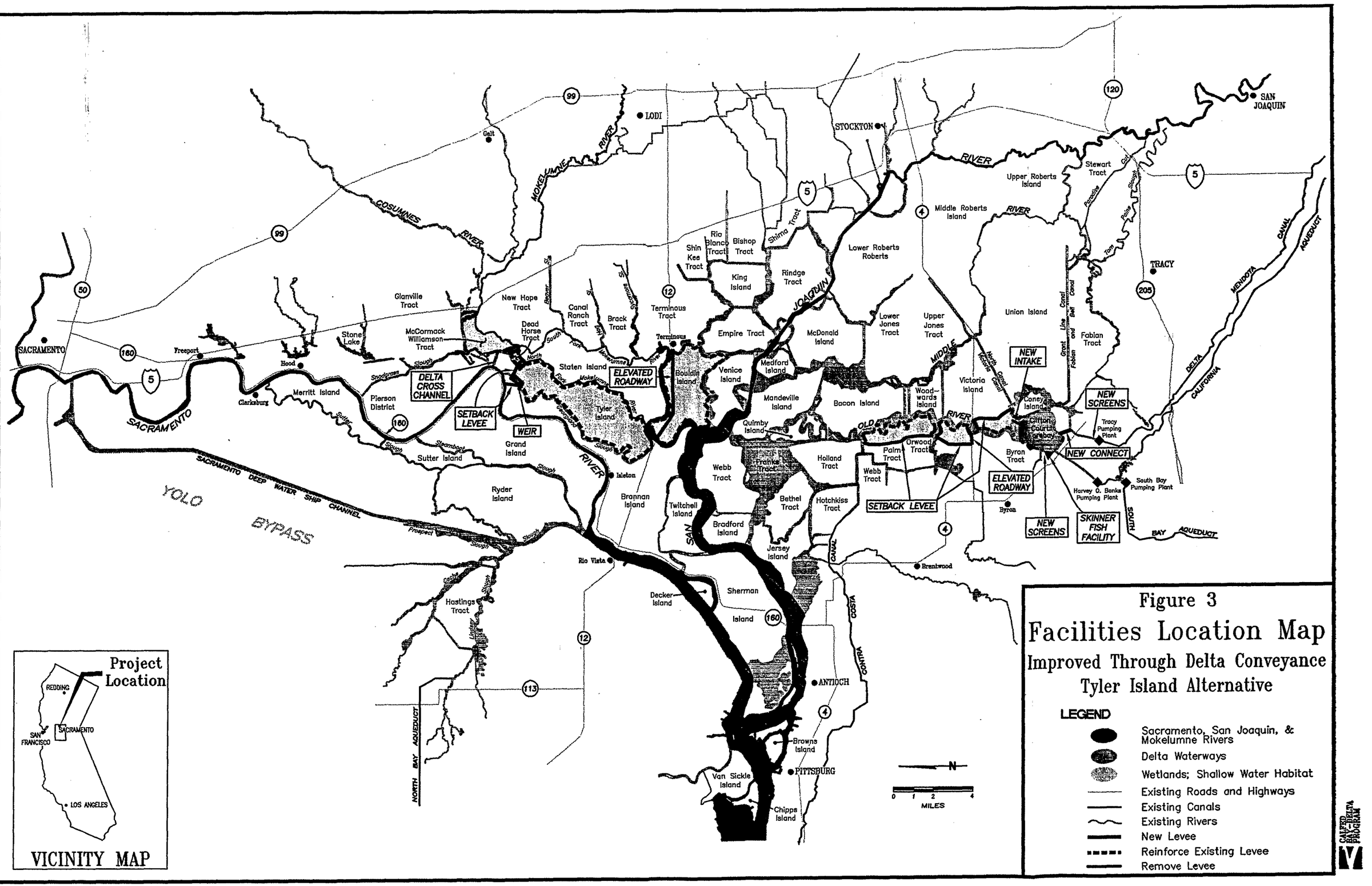

Figure 3

Facilities Location Map

Improved Through Delta Conveyance
Tyler Island Alternative

LEGEND

- Sacramento, San Joaquin, & Mokelumne Rivers
- Delta Waterways
- Wetlands; Shallow Water Habitat
- Existing Roads and Highways
- Existing Canals
- Existing Rivers
- New Levee
- Reinforce Existing Levee
- Remove Levee

CALFED BAY-DELTA PROGRAM

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FACILITY DESCRIPTIONS AND COST ESTIMATE FOR A WESTERN DELTA ISOLATED CONVEYANCE FACILITY

Prepared by the CALFED Storage and Conveyance Refinement Team

October 1997

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INTRODUCTION

The *Facility Descriptions and Cost Estimate for a Western Delta Isolated Conveyance Facility* has been prepared as part of the Storage and Conveyance Component Refinement Task of the CALFED Bay-Delta Program (CALFED or Program). CALFED's mission is to develop a long-term comprehensive plan that will restore the ecological health and improve water management for beneficial uses of the San Francisco Bay/Sacramento-San Joaquin Delta (Bay-Delta) system.

This report summarizes the principal features, estimated capital costs, and environmental considerations of constructing a hydraulically isolated conveyance facility from the Sacramento River to Clifton Court Forebay along the western perimeter of the Sacramento-San Joaquin Delta (Delta). The general location of the Western Delta Isolated Conveyance Facility (Western Delta Facility) is shown in Figure 1. The Western Delta Facility would utilize the Sacramento Ship Channel as the first leg of the isolated conveyance system. The conveyance system would also include a pipeline, a tunnel crossing of the western perimeter of the Delta, and an open canal through Contra Costa County discharging to Clifton Court Forebay.

This evaluation and others being performed by CALFED are intended to provide facilities descriptions and updated cost estimates of representative storage and conveyance components. The objectives of the Western Delta Facility evaluation are to (1) provide an estimate of the capital cost of constructing this facility within the range expected if the project were to be constructed today and (2) enable CALFED to compare this project against other projects that might be considered as part of a long-term CALFED solution strategy.

The estimated capital cost for the Western Delta Facility was determined primarily from conceptual designs developed by Bookman-Edmonston Engineering. The Western Delta Facility is a relatively new concept being considered in the CALFED process. As such, previously

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published or unpublished materials providing a description of the project or an estimate of the cost of developing the project were not available.

A preliminary evaluation of the environmental considerations associated with the Western Delta Facility has been included in this report. Fish, wildlife, plant, and cultural resources that could be affected have been described and potential impacts have been identified. The information for the evaluation of environmental considerations was gathered from existing literature and databases.

PROJECT BACKGROUND

Development of the Delta began in the 19th century. Reclamation of Delta marshlands began in the 1850s, and by the 1930s, nearly all of the Delta had been reclaimed into intensively farmed islands. Ocean salinity intrusion to the interior of the Delta was observed as early as the 1840s and was recognized as a potential problem to water supplies. Since that time, there have been numerous studies of methods to control salinity intrusion and otherwise improve the management of the water resources of the Delta.

In 1957, the California Department of Water Resources (DWR) published Bulletin 3 that, as a part of a comprehensive statewide water facilities planning effort, defined a western Delta isolated conveyance facility. This facility was a component of a large conveyance and storage system reaching from Lake Shasta in Northern California to Southern California.

In 1960, California voters approved the Burns-Porter Act to assist in the financing of the State Water Project (SWP). This Act authorized Delta facilities "... for water conservation, water supply in the Delta, transfer of water across the Delta, flood and salinity control, and related functions." In the same year, DWR proposed the Delta Water Project to serve as the Delta water facility of the SWP. This plan, however, was met with stiff opposition from Delta water users,

boaters, fish and wildlife agencies, and other Delta interests. Consequently, DWR and the California Department of Fish and Game (CDFG) established the Delta Fish and Wildlife Protection Study, the Interagency Delta Commission (with the U.S. Bureau of Reclamation (Reclamation), and the U.S. Army Corps of Engineers) to develop a mutually acceptable plan for the Delta. In 1965, the Interagency Delta Commission recommended the Peripheral Canal as the water transfer plan. The Peripheral Canal was to convey water from the Sacramento River at Hood to the State and federal pumping plants in the south Delta. The Peripheral Canal would eliminate interference with Delta waterways and would release freshwater to Delta channels to maintain water quality and mitigate impacts to fish.

In 1966, DWR designated the Peripheral Canal as the Delta Facility of the SWP. In 1969, the Department of the Interior (Interior) adopted Reclamation's Peripheral Canal Feasibility Report, which recommended that the project be a joint-use facility of the SWP and the Central Valley Project (CVP) with costs shared equally. Although the Peripheral Canal was supported by two subsequent administrations, the facility was never constructed, partly for the following reasons:

- Although the Interior and Reclamation supported the facility, federal funding was never forthcoming.

- There was continuing fear of and controversy over the cost of the canal and of potential harm from improper operation. Some water users believed that water could be obtained at a lower cost. Also, some Delta interests feared that in times of water shortage, institutional, statutory, and contractual guarantees for Delta protection could be changed or ignored and water needed to protect the Delta would be exported.

In 1975, DWR began to reassess the Peripheral Canal resulting in DWR Bulletin 76 (July 1978), which identified and considered numerous alternative water transfer facilities. In 1980, the State

Legislature passed, and the Governor signed, Senate Bill (SB) 200. This bill authorized the Peripheral Canal and provided specific guarantees to protect the Delta and to meet the water needs of the SWP through the year 2000. SB 200 was subjected to a referendum vote in June 1982, which California voters did not approve.

Since the rejection of SB 200, alternative water transfer plans for the Delta have been investigated by DWR and other agencies. In 1983, DWR published *Alternatives for Delta Water Transfer*, which examined four alternatives for improving the water transfer system. The alternatives examined in the DWR report included a dual transfer facility that included an isolated conveyance facility (similar to the Peripheral Canal) and improvements to channel conveyance capacities in the north and south Delta. None of the DWR investigations, however, focused on a hydraulically isolated western Delta crossing.

In the process of developing a long-term comprehensive plan to restore the ecological health of and improve water management in the Bay-Delta, CALFED has received suggestions from participating agencies and stakeholders. The conceptual approach to an isolated conveyance facility described in this report was suggested to explore several possible combinations of synergistic actions, including the enlargement and extension of the Tehama-Colusa Canal to Clifton Court Forebay, off-stream storage on the west side of the Sacramento Valley, and a screened diversion facility upstream of critical Delta Smelt habitats to deliver Sacramento River water to Clifton Court Forebay. The evaluation for the Western Delta Facility is being completed to enable it to be compared to other Delta conveyance facilities. CALFED is also evaluating an isolated conveyance facility along the eastern perimeter of the Delta in a reported titled *Facilities Descriptions and Updated Cost Estimates for an Isolated Delta Conveyance Facility* and improvements to through Delta channel conveyance capacities in a report titled *Facility Descriptions and Cost Estimates for an Improved Through Delta Conveyance Facility.*

FACILITIES DESCRIPTION

The Western Delta Facility would transfer flows from the Sacramento River to Clifton Court Forebay through a conveyance system that would be hydraulically isolated from the Delta's channels. The conveyance capacity of the Western Delta Facility would be 5,000 cfs. The first reach of the conveyance system would be the Sacramento Deep Water Ship Channel (Ship Channel). The Ship Channel would serve as a conveyance canal for Sacramento River water diverted through a fish screening facility constructed at the Port of Sacramento. Delta water would be prevented from entering the downstream end of the Ship Channel by a lock structure, which would allow continued operation of the Port of Sacramento. A pump station just upstream of the lock structure would pump water into a pipeline, the Sacramento River Pipeline, which would convey water southward along the Montezuma Hills. The conveyance facility would transition to a tunnel crossing beneath the western Delta, the Western Delta Tunnel. The Western Delta Tunnel would extend 23,000 feet beneath the western end of Sherman Island and the Sacramento and San Joaquin Rivers. From the outlet of the tunnel, the South Delta Canal would convey water to Clifton Court Forebay. This configuration of the Western Delta Facility has been developed to a conceptual design level by Bookman-Edmonston Engineering and CALFED staff.

The Western Delta Facility would provide higher quality Sacramento River water to Clifton Court Forebay and at the same time reduce the demand for pumping from south Delta channels. This isolated conveyance system could be used to improve the water quality of supplies provided by the SWP and the CVP, add flexibility to both projects' Delta operations, and reduce impacts to Delta fisheries.

PROJECT LOCATION

The general project location of the Western Delta Facility can be seen in Figure 1. The conveyance facility would begin in Yolo County at the Port of Sacramento and would continue south through Solano and Contra Costa Counties. Figure 2 provides a more detailed map of the locations of the facilities associated with Western Delta Facility.

PROJECT DESCRIPTION

The Western Delta Facility would convey Sacramento River flows to Clifton Court Forebay via an isolated conveyance system around the western perimeter of the Delta. This isolated conveyance system would provide higher quality Sacramento River water to Clifton Court Forebay, which could be used to improve the overall quality of supplies provided by the SWP and CVP. The system would also relocate a portion of the south Delta pumping demands for the SWP and CVP to the Sacramento River where impacts to fisheries may be lessened under certain conditions and during certain periods critical to Delta fisheries. Additionally, relocating a portion of the south Delta pumping demand to the Sacramento River could improve the reliability of SWP and CVP water supplies.

PRINCIPAL FACILITIES

The Western Delta Facility would utilize the Ship Channel as the first reach of the conveyance system. Modifications to the Ship Channel would include a screened diversion facility from the Sacramento River into the upstream end of the channel and a ship lock at the downstream end of the channel to isolate it from the Delta while continuing to allow large ship traffic to utilize the channel. At the downstream end of the Ship Channel water would be pumped into the Sacramento River Pipeline, which would follow along the west bank of the Sacramento River to 8 miles downstream of Rio Vista. The pipeline would discharge to the Western Delta Tunnel,

which would cross beneath the western Delta. The tunnel would resurface east of Antioch and would transition to the South Delta Canal, which would convey water to Clifton Court Forebay.

The facilities associated with the Western Delta Facility are described in greater detail in the following section. A summary of the physical characteristics of these facilities is provided in Table 1 and their general locations are shown in Figure 2.

Sacramento River Deep Water Ship Channel Intake

The intake facility for the Ship Channel would be located where the channel currently connects with the Sacramento River in West Sacramento. The intake facility would include a trashrack, flood gates, a sedimentation basin, a low-lift pumping station, and a fish screening and bypass facility. These facilities would be located approximately where Jefferson Boulevard crosses Barge Canal.

The pumping plant, which would be located downstream of the sedimentation basin and fish screens, would create the hydraulic head necessary to convey 5,000 cfs through the Ship Channel and for controlling the hydraulics of the fish screening facility. The low-lift pumping station would have a total capacity of 5,000 cfs. During periods when sufficient head would be available to divert flows into the Ship Channel without pumping, flows could be routed through a bypass structure and flow by gravity to the Sacramento River Pipeline Pumping Facility, which would pump water into the Sacramento River Pipeline.

Sacramento River Deep Water Ship Channel

In order to maintain operations of the Port of Sacramento, a ship lock would be constructed at the downstream end of the Ship Channel, 19 miles downstream of the channel intake structure. The

lock would prevent lower quality Delta water and fish from entering the Ship Channel while continuing to allow large ship traffic in the channel.

The ship lock required to allow passage of the maximum ship size that currently uses the Ship Channel would have dimensions of 800 feet long, 200 feet wide, and 40 feet tall. The lock would accommodate several feet of lift, which might be required during low tide conditions.

Sacramento River Pipeline

At the downstream end of the Ship Channel an unscreened pumping plant, the Sacramento River Pipeline Pumping Plant, would pump water into the pressurized Sacramento River Pipeline. The pumping plant would be located on the west levee of the Ship Channel and would have a capacity of 5,000 cfs. The pipeline would follow the Sacramento River to 8 miles downstream of Rio Vista.

The Sacramento River Pipeline would consist of three 18-foot inside-diameter, cast-in-place, concrete pipes. The pipeline would be buried and would have an alignment length of 10.6 miles. Figure 3 shows a typical pipe trench section for this pipeline. From the pumping plant at the bottom of the Ship Channel, the pipeline would siphon under Cache Creek and travel in a southerly direction toward town of Rio Vista. From Rio Vista, the pipeline alignment would follow the west bank of the Sacramento River along the Montezuma Hills. The pipeline's terminus would be 8 miles downstream of Rio Vista where the conveyance system would transition to a tunnel crossing beneath the western end of the Delta.

Western Delta Tunnel

The Western Delta Tunnel would begin on the west bank of the Sacramento River and traverse beneath the Sacramento River, the western end of Sherman Island, and the San Joaquin River in

a southerly direction. The tunnel would resurface about 3 miles east of Antioch on the south shore of the San Joaquin River. The tunnel would require an inside diameter of 27 feet and a total length of just over 4 miles. This tunnel configuration would convey the 5,000 cfs design flow of the Western Delta Facility. Figure 4 shows a schematic-profile of the Western Delta Tunnel crossing beneath the western portion of the Delta. As can be seen in the schematic, the tunnel crown would be about 40 feet below the invert elevations of the Sacramento and San Joaquin River channels.

The Western Delta Tunnel would be bored through soft peak soils that underlie much of western Delta. Constructing a tunnel in such conditions would be a significant engineering challenge. However, a preliminary review of the current state of technology for tunnel boring indicates that a tunnel could be constructed under the soft soil conditions found in this region of the Delta. Earth Pressure Balance tunnel boring machines have been developed that would provide positive support across the full diameter of an unstable tunnel face. Under soft face tunneling conditions, stability of the tunnel face would be achieved by maintaining a constant forward thrust pressure against the face and by regulating the flow of muck leaving the cutting head chamber of the tunnel boring machine. Additives could also be added to the tunnel face to enhance face support. The tunnel lining would consist of a series of rings of reinforced concrete segments and one trapezoidal key. The ring supports would be placed along the entire length of the tunnel and the inside face would be grouted and lined with concrete.

South Delta Canal

From the outlet of the Western Delta Tunnel, the South Delta Canal would convey water to Clifton Court Forebay. The capacity of the canal would match the design capacity of the conveyance system, 5,000 cfs. The canal would have a total length of about 16 miles and would be concrete-lined. The canal would have a trapezoidal cross-section with side slopes of 2:1 and a

bottom width of 40 feet. The depth of the canal would be 16 feet from the normal water surface elevation in the canal.

The South Delta Canal would require several major crossings; Highway 4 in the city of Oakley and again south of Brentwood, the Contra Costa Canal east of Oakley, the Mokelumne Aqueduct east of Brentwood, Marsh and Kellogg Creeks, and Italian Slough. All major crossings would be made through a siphon complex consisting of three concrete box siphons with dimensions of 26' x 26' by the length of the crossing.

COST ESTIMATE

The cost estimate for the Western Delta Facility is based on original work and conceptual designs developed by Bookman-Edmonston Engineering and CALFED staff. As the Western Delta Facility is a concept that has not received extensive attention by DWR or Reclamation in the past, no detailed resources were available that described this project or provided a cost estimate. The cost estimate developed in this evaluation represents the estimated capital cost of constructing the Western Delta Facility. Additional project costs such as environmental documentation and mitigation, operation and maintenance, power, and interest during construction, are not included in this estimate.

COST ESTIMATE METHODOLOGY

The estimated capital cost of constructing the Western Delta Facility was determined by applying current unit costs to quantities developed by Bookman-Edmonston Engineering in conceptual designs developed for project facilities. Table 2 provides a detailed breakdown of the estimated capital cost of constructing the Western Delta Facility with a total conveyance capacity of 5,000 cfs. This table provides the quantities of the cost item and its unit cost or an indication that the estimated cost has been developed through a lump sum approach accompanied by the total

cost of the task. A more detailed description of the development of the cost estimates for the major features of the Western Delta Facility is provided in the following paragraphs.

Sacramento Deep Water Ship Channel Ship Lock Cost

The cost estimate for the ship lock located at the bottom of the Ship Channel was developed from reviewing actual construction costs of similar locks constructed in the United States. Two ship locks were chosen as the basis of the present cost estimate. These locks are located in New Poe, Michigan, and at the Bonneville Dam on the Columbia River, constructed in 1970 and 1993, respectively. The construction cost of these locks were reviewed and a ratio of total construction dollars per square foot of lock gate was determined. The ship lock at the Ship Channel would require two 200 feet wide by 40 feet tall gates. The resulting cost for the lock required for the Western Delta Facility would be approximately $350 million.

Western Delta Tunnel Cost

The cost estimate for the Western Delta Tunnel was developed from the actual construction cost of the St. Clair River Tunnel, which was completed in 1994. The St. Clair River Tunnel connects Sarnia, Ontario, Canada to Port Huron, Michigan in the United States. The St. Clair River Tunnel was chosen as the basis for determining costs for the Western Delta Tunnel because of the similarity in soil conditions and tunnel size. The actual construction costs were escalated to October 1996 dollars by using Reclamation's Construction Cost Trends indices. To determine the cost for the Western Delta Tunnel, a cost per linear foot of tunnel was developed from the escalated actual construction costs of the St. Clair River Tunnel. The estimated cost per linear foot of tunnel was then applied to the length of the Western Delta Tunnel.

Pumping Plants

The cost estimate for the Sacramento River Pipeline Pumping Plant was based on the actual construction costs for the Waddell Pumping-Generating Plant in Arizona, which was completed in 1994 and is similar in size and scope to the Sacramento River Pipeline Pumping Plant. To develop a cost for this pumping plant, the actual construction cost of the Waddell Pumping-Generating Plant (escalated to October 1996 dollars) was factored by the following empirical equation:

$$\frac{(Cost)_1}{(Cost)_2} = \frac{HP_1^{6/10}}{HP_2^{6/10}}$$

where HP is equal to horsepower.

This cost factor formula is typically valid over moderate ranges in horsepower; the validity over larger ranges is undetermined. The impact of any error resulting from utilizing this ratio beyond its valid range is considered to be within the accuracy of the present cost estimate.

The cost estimate for the low-lift pumping plant associated with the Ship Channel Intake Facility was based on costs and quantities from the September 1995 DWR report titled *Isolated Transfer Facility Cost Estimate.* These costs were originally priced in July 1995 dollars and have been updated to October 1996 dollars using the CCT indices described above.

Right-of-Way Costs

Right-of-way costs of $10,000 per acre were based on land use costs developed by Reclamation, Land Resources Branch (Personal Communication, March 1997). Reclamation provided land use cost estimates at a subappraisal level for all storage and conveyance components reviewed by

CALFED. The right-of-way cost are significantly higher for the Western Delta Facility than for other projects being evaluated by CALFED. The high right-of-way cost is attributable to high land values in Contra Costa County and the high cost of purchasing a right-of-way for the Sacramento Deep Water Ship Channel.

Contingencies and Other Costs

All contingencies and engineering, construction management, and administrative factors were determined by engineering judgment based on similar levels of cost estimation. Contingencies were chosen to be 20 percent; and engineering, construction management, and administration were chosen to be 35 percent. A cost range was developed for the project by subtracting 10 percent from the estimated capital cost for the low-end cost and adding 25 percent to the estimated capital cost for the high-end cost.

PRELIMINARY COST FINDINGS

The estimated capital cost of the Western Delta Facility and its supporting features have been updated to an October 1996 basis as described above. Table 3 summarizes estimated capital costs for this project.

The total estimated capital cost of the 5,000 cfs Western Delta Facility alternative is approximately $2,338 million with a resulting calculated range of costs between $2,104 and $2,630 million.

ENVIRONMENTAL CONSIDERATIONS

[NOTE: The Environmental Considerations section needs to be reevaluated by DWR to ensure consistency with the information presented in the pervious section.]

This portion of the report provides a summary of environmental considerations related to the Western Delta Facility. Fish, wildlife, plant, and cultural resources that could be affected are described and the extent of the impacts is identified. For the most part, the information presented in this section was gathered from existing literature, with limited original research. No field work was conducted for this analysis.

WILDLIFE

The proposal is not expected to result in any significant long-term terrestrial impacts associated with the construction of the facilities. The major concern would be the effect of altering the volume of water entering the Delta. Because the diversion would be upstream of the Delta, impacts would be fewer on the Delta ecosystem than current diversions in the southern Delta or diversions associated with proposed isolated Delta conveyance facilities.

Fish, Amphibians, Reptiles, and Invertebrates

Diverting water from the Sacramento River into the Sacramento Ship Channel could result in adverse impacts to migrating juvenile and adult anadromous fish. The degree of fish losses at the Sacramento River diversion is unknown, but it is likely that migrating fish would be subjected to increased predation, entrainment at the screens, and adverse water temperature changes.

General Wildlife

Freshwater marshes within the area of the proposed conveyance may provide important habitat for waterfowl and a variety of other wildlife species, including grebes, herons, egrets, bitterns, coots, shorebirds, rails, hawks, owls, muskrat, raccoon, opossum, and beaver. Many other upland species such as ring-necked pheasant, California quail, and black-tailed hare take cover and forage at the margins of these wetland habitats.

The grassland habitats in the area may provide valuable foraging areas for several species of birds including black-shouldered kite, red-tailed hawk, Swainson's hawk, northern harrier, American kestrel, yellow-billed magpie, loggerhead shrike, savannah sparrow, mourning dove, and a variety of songbirds. These areas may provide important foraging habitat for coyote and badger since this type of areas generally support large populations of their prey base: deer mouse, California vole, pocket gopher, and ground squirrel. Common reptiles and amphibians of grasslands habitats may include western fence lizard, common king snake, western rattlesnake, gopher snake, common garter snake, western toad, and western spadefoot toad.

Sensitive and Listed Fish and Wildlife Species

According to CDFG's California Natural Diversity Data Base records (Version 8/96), nine State or federally listed species and 22 candidates for listing, species designated by CDFG as species of special concern have been known to occur in or near the area affected by the proposed project.

Listed wildlife species that could be affected by the project include California red-legged frog (federal threatened), Swainson's hawk (State threatened), California black rail (State threatened), Salt Marsh harvest mouse (federal endangered, State endangered), San Joaquin kit fox (federal endangered, State threatened), giant garter snake (federal and State threatened), longhorn fairy

shrimp (federal endangered), Langes meadowmark butterfly (federal endangered), and the Valley elderberry longhorn beetle (federal threatened).

Wildlife species that are either candidates for State or federal listing or considered of special concern by the CDFG that could be affected by the proposed conveyance include California tiger salamander (federal candidate/CDFG species of special concern), California red-legged frog (federal species of concern/CDFG species of special concern), double-crested cormorant (CDFG species of special concern), white-tailed kite, burrowing owl (CDFG/Audubon species of special concern), California horned lark (CDFG species of special concern), tri-colored blackbird (federal candidate/CDFG species of special concern), Sacramento splittail (federal proposed endangered/CDFG species of special concern), Sacramento perch (federal candidate/ CDFG species of special concern), San Joaquin pocket mouse (CDFG species of special concern), western pond turtle (federal candidate/CDFG species of special concern), curved foot hygrotus diving beetle (federal candidate), Antioch Cophuran robberfly (federal candidate), Antioch Efferian robberfly (federal candidate), yellow banded andrenid bee (federal candidate), Antioch multilid wasp (federal candidate), Antioch specid wasp (federal candidate), Middlekaufs katydid (federal candidate), Antioch Dunes anthicid beetle (federal candidate), Sacramento anthicid beetle (federal candidate), and molestan blister beetle (federal candidate).

VEGETATION

Vegetation along the proposed alignment of the Western Delta Facility and Western Delta Crossing consists primarily of agricultural lands, grasslands, disturbed lands, woodlands, and riparian/marsh.

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Sensitive and Listed Plant Species

Federal- or State-listed plants that have been known to occur in or around the area that could be affected by the proposed conveyance and crossing include Contra Costa wallflower (federal and State endangered), Mason's lilaeopsis (federal candidate, State rare), soft bird's beak (federal and State endangered), and Antioch Dunes evening-primrose (federal and State endangered).

Candidate plant species for federal listing that may occur in the project area include Suisun Marsh aster, Contra Costa goldfields, caper-fruited tropidocarpum, San Joaquin saltbush, Ferris's milk-vetch, Northern California black walnut, diamond-petaled California Poppy, recurved larkspur, and fragrant fritillary.

Rayless ragwort, dwarf dowingia, heartscale, brittlescale, alkali milk-vetch, Mt. Diablo manzanita, California hibiscus, and Delta mudwart, listed by the California Native Plant Society as being rare, threatened, or endangered in California and elsewhere, could also be affected by the proposed conveyance and crossing.

Special status habitats that may be found along or near the area of the proposed conveyance and crossing include valley needle grass grassland, Great Valley cottonwood riparian forest, elderberry savanna, and stabilized interior dunes.

WETLANDS

Wetlands that would be affected include approximately 4 miles of farmed wetland, 17 miles of upland, 6 miles of emergent, regularly flooded wetlands, 1 mile of emergent, deep marsh, and 9 miles of intermittently exposed, permanent open water along an excavated shallow marsh. The proposed conveyance would cross tidal open water (Sacramento River), the San Joaquin River, intermittent streambed, estuarine, subtidal wetlands (Mayberry Slough), emergent wet meadow,

emergent, shallow marsh, emergent, deep marsh (three crossings), emergent, tidal, shallow marsh, unconsolidated shore, wet meadow, four drainage canals, and shrub-scrub, emergent deep marsh.

Special status wetland habitats that may be found along or near the area of the proposed conveyance and crossing include alkali meadow, alkali seep, northern claypan vernal pool, Coastal and Valley freshwater marsh and Coastal brackish marsh, and cismontane alkali marsh.

CULTURAL RESOURCES

No information on cultural resources in the project area is available at this time.

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Table 1
SUMMARY OF PHYSICAL CHARACTERISTICS
WESTERN DELTA ISOLATED CONVEYANCE FACILITY

Sacramento Deep Water Ship Channel	
Intake Facility	
Fish Screens (capacity - cfs)	5,000
Pumping Plant	
Capacity (cfs)	5,000
Power Requirement (HP)	8,360
Ship Lock	
Length Between Gates (feet)	800
Gate Width (feet)	200
Gate Height (feet)	40
Lift (feet)	2
Sacramento River Pipeline	
Pumping Plant	
Capacity (cfs)	5,000
Power Requirement (HP)	85,000
Capacity for all Barrels (cfs)	5,000
Barrels (diameter in feet)	18
Number of Barrels	3
Length of Alignment (feet)	56,000
Western Delta Tunnel	
Length (feet)	23,000
Bore Diameter (feet)	32
Finished Diameter (feet)	27
Capacity (cfs)	5,000
South Delta Canal	
Length (feet)	80,000
Capacity (cfs)	5,000
Type	Concrete lined

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Table 2
ESTIMATED CAPITAL COSTS
WESTERN DELTA ISOLATED CONVEYANCE FACILITY

DESCRIPTION	QUANTITY	UNIT[a]	UNIT COST OCT. '96	TOTAL COST OCT. '96	REF.
I. SACRAMENTO DEEP WATER SHIP CHANNEL					
Fish Screens	Job	LS	$50,000,000	$50,000,000	1
Low-Lift Pumping Plant	Job	LS	$41,695,000	$41,695,000	1
Ship Lock	Job	LS	$350,000,000	$350,000,000	1
Trash Rack, Sedimentation Basin, and Other Intake Facilities	Job	LS	$7,000,000	$7,000,000	1
SUBTOTAL SACRAMENTO DEEP WATER SHIP CHANNEL				$448,695,000	
II. SACRAMENTO RIVER PIPELINE					
Cofferdams and Dewatering at Cache Slough	Job	LS	$2,700,000	$2,700,000	1
Bypass Channel	Job	LS	$2,500,000	$2,500,000	1
Concrete Encasement of Pipes at Cache Slough	42,100	CY	$200.00	$8,420,000	1
18-ft. Dia. Cast-in place Concrete Pipe (3 Barrels)	168,000	LF	$2,840	$477,120,000	2
Pumping Plant	Job	LS	$120,000,000	$120,000,000	
Rights-of-way	200	AC	$10,000	$2,000,000	1
SUBTOTAL SACRAMENTO RIVER PIPELINE				$612,740,000	
III. WESTERN DELTA TUNNEL					
Enclosed Concrete Transition from Pipelines to Tunnel	1,950	CY	$600	$1,170,000	1
27-ft. Dia. Tunnel	23,000	LF	$12,000	$276,000,000	1
Access Ramps	Job	LS	$6,800,000	$6,800,000	1
Enclosed Concrete Transition from Tunnel to Pipelines	1,950	CY	$600	$1,170,000	1
SUBTOTAL WESTERN DELTA TUNNEL				$285,140,000	
IV. PIPELINE FROM TUNNEL TO SOUTH DELTA CANAL					
18-ft. Dia. Cast-in-place Concrete Pipe (3 Barrels)	15,000	LF	$2,840	$42,600,000	2
Concrete Transition - Pipelines to Open Channel	1,100	CY	$600	$660,000	1
SUBTOTAL PIPELINE FROM TUNNEL TO SOUTH DELTA CANAL				$43,260,000	
V. SOUTH DELTA CANAL					
Excavation	3,696,000	CY	$2.00	$7,392,000	1
Compacted Embankment	168,000	CY	$0.80	$134,400	1
Common Embankment	500,000	CY	$0.50	$250,000	1
Concrete Lining	86,080	CY	$80.00	$6,886,400	1
Contra Costa Canal Undercrossing	Job	LS	$150,000	$150,000	1
Marsh Creek Undercrossing	Job	LS	$150,000	$150,000	1

Table 2
ESTIMATED CAPITAL COSTS
WESTERN DELTA ISOLATED CONVEYANCE FACILITY

DESCRIPTION	QUANTITY	UNIT[a]	UNIT COST OCT. '96	TOTAL COST OCT. '96	REF.
Mokelumne Aqueduct Undercrossing	Job	LS	$150,000	$150,000	1
Italian Slough Siphon:					
3-26'x26' Concrete Box	11,700	CY	$600	$7,020,000	1
Transition Concrete	6,400	CY	$600	$3,840,000	1
Cofferdams (2)	Job	LS	$508,000	$508,000	1
Bypass Channel	Job	LS	$1,183,000	$1,183,000	1
Dewatering	Job	LS	$1,159,000	$1,159,000	1
Railroad Bridges	2	EA	$1,033,000	$2,066,000	1
County Road Bridges - 16 ea. @ 6,300 sq. ft.	100,800	SF	$100	$10,080,000	1
Farm Road Bridges - 9 ea. @ 4,500 sq.ft.	40,500	SF	$100	$4,050,000	1
Irrigation and Drainage Undercrossings	8	EA	$102,000	$816,000	1
Fencing	160,000	LF	$5.00	$800,000	1
Rights-of-way	650	AC	$10,000	$6,500,000	1
SUBTOTAL SOUTH DELTA CANAL				$53,134,800	
SUBTOTAL				$1,443,000,000	
CONTINGENCIES @ 20 %				$288,600,000	
SUBTOTAL				$1,731,600,000	
ENG., LEGAL, AND ADM. @ 35 %				$606,100,000	
ESTIMATED CAPITAL COST				**$2,337,700,000**	
ESTIMATED CAPITAL COST RANGE					
LOW (-10%)				$2,104,000,000	
HIGH (+25%)				$2,630,000,000	

Footnotes:
aLS=lump sum; CY=cubic yard; LF=linear foot; AC=acre; EA=each; SF=square foot

Cost Reference:
1. Cost developed by Bookman-Edmonston Engineering.
2. Cost developed for "Isolated Conveyance Facilities - 15,000 cfs" cost estimate.
3. California Department of Water Resources, *ISDP Cost Estimate: Proposed Clifton Court Forebay Northern Intake Structure*, October 1993.

Table 3
SUMMARY OF ESTIMATED CAPITAL COSTS
WESTERN DELTA ISOLATED CONVEYANCE FACILITY

Cost Item	Estimated Cost ($Millions)
Sacramento Deep Water Ship Channel	448.7
Sacramento River Pipeline	612.7
Western Delta Tunnel	285.1
Pipeline from Tunnel to South Delta Canal	43.3
South Delta Canal	53.1
TOTAL	1,443.0
Contingencies (20%)	288.6
ESTIMATED CONSTRUCTION COST	1,731.6
Engineering, Legal, and Project Administration (35%)	606.1
ESTIMATED CAPITAL COST	2,337.7
Capital Cost Range (minus 10% - plus 15%)	$2,104 - $2,630

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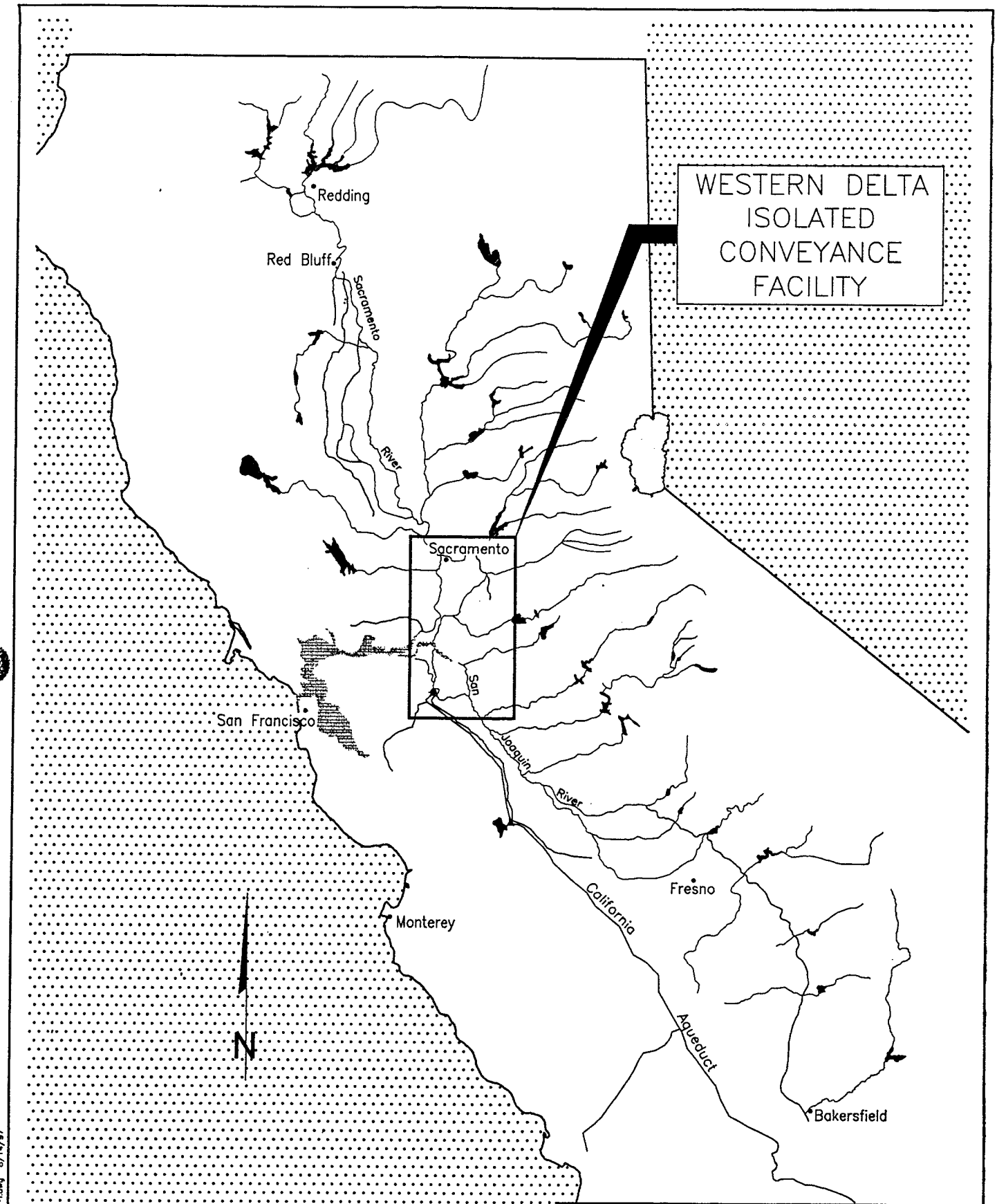

Figure 1
Project Location Map
Western Delta Isolated
Conveyance Facility

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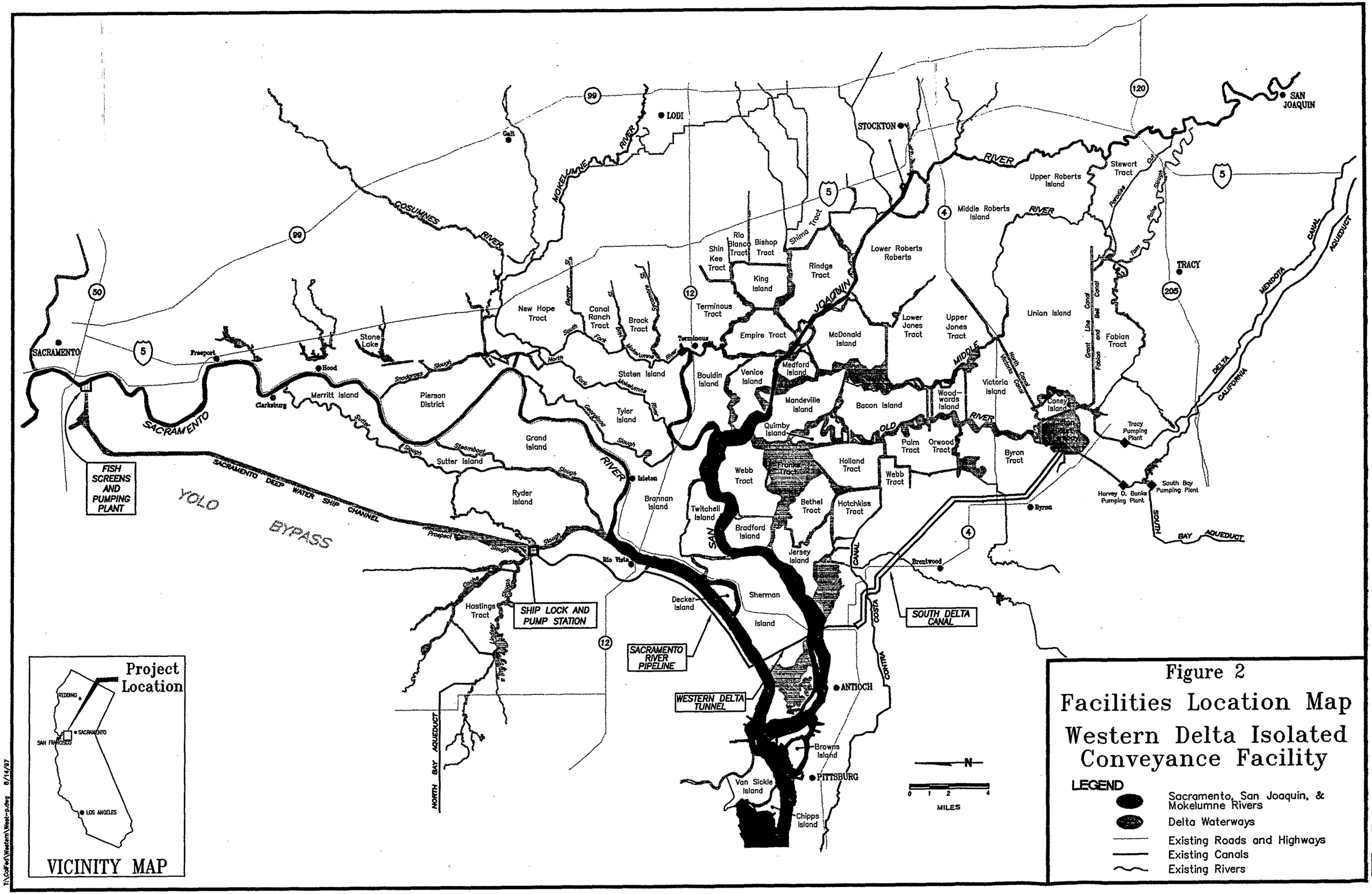

Figure 2

Facilities Location Map
Western Delta Isolated Conveyance Facility

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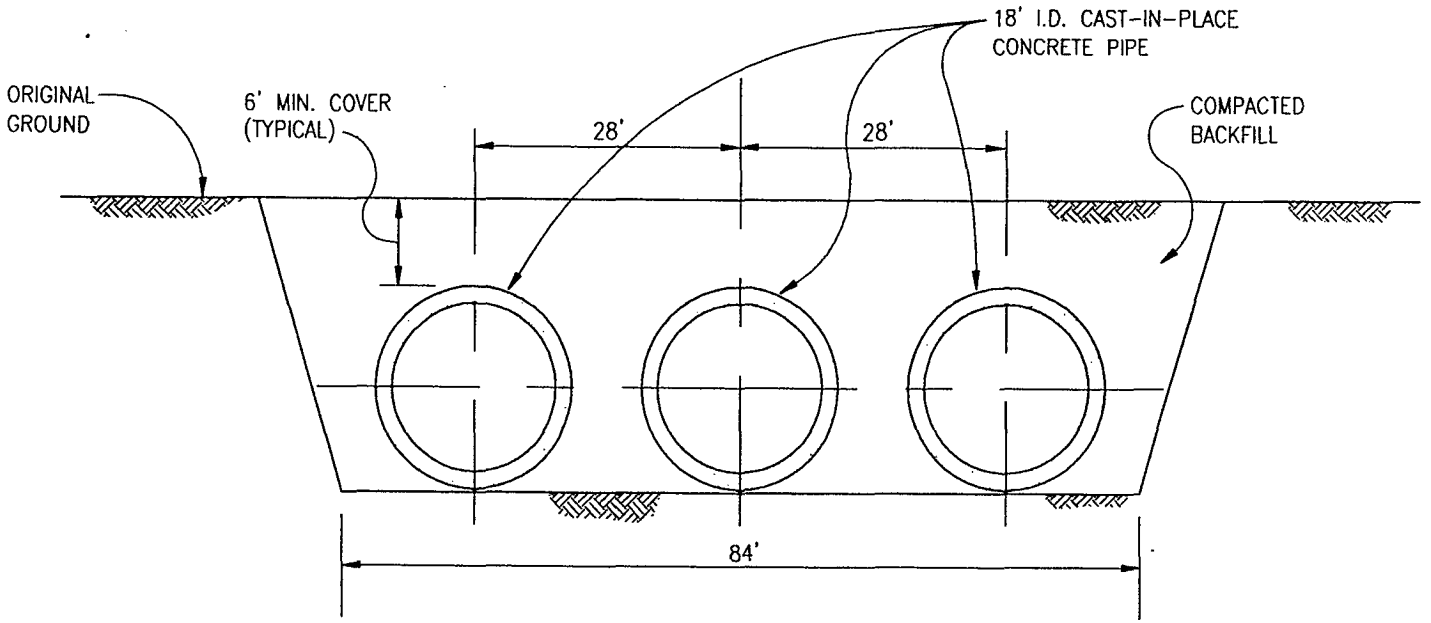

TYPICAL PIPE TRENCH SECTION

NOT TO SCALE

Figure 3

Western Delta Isolated Conveyance Facility

Sacaramento River Pipeline
Typical Pipe Trench Section

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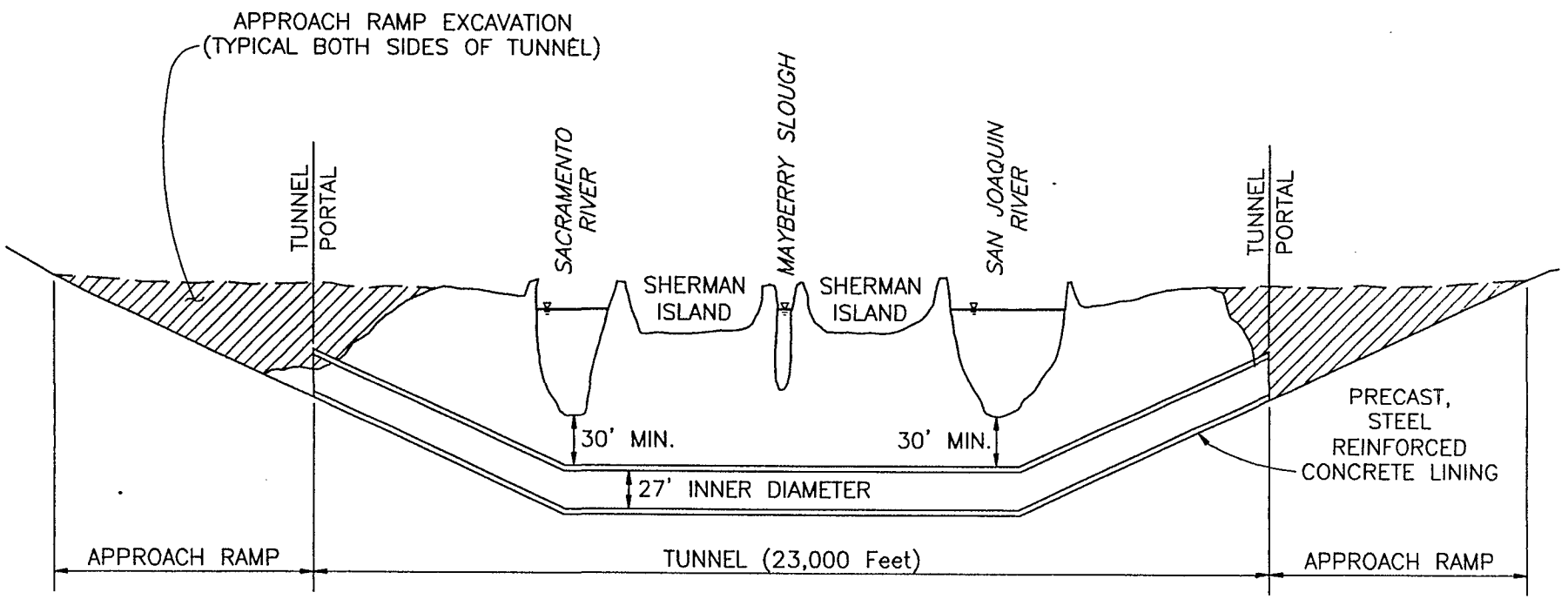

Figure 4

Western Delta Isolated Conveyance Facility

Western Delta Tunnel Cross Section

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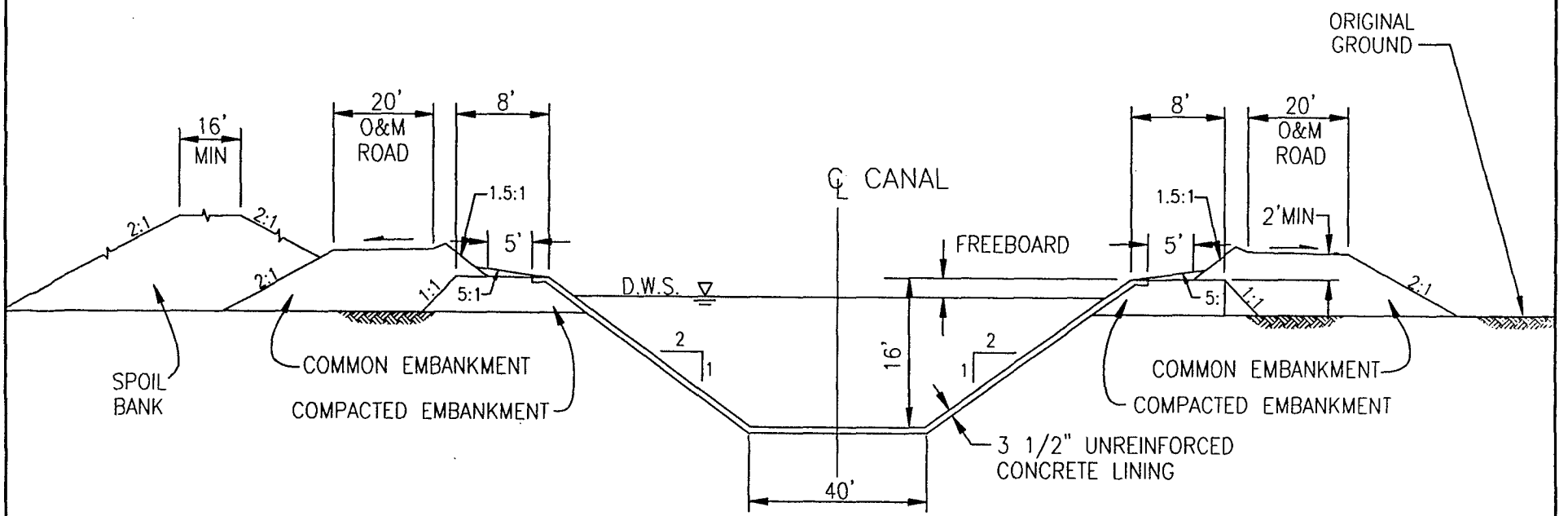

CANAL IN FILL
NOT TO SCALE

Figure 5

Western Delta Isolated Conveyance Facility

South Delta Canal
Typical Canal Section

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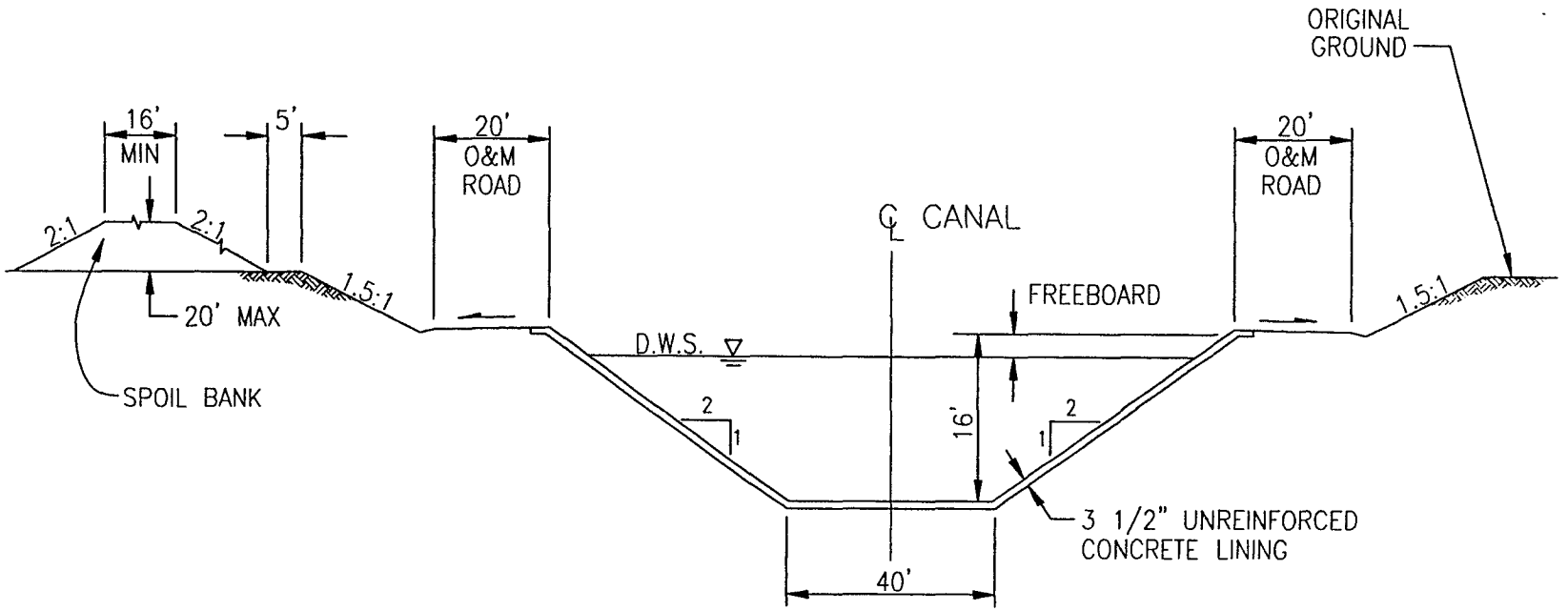

CANAL IN CUT
NOT TO SCALE

Figure 6

Western Delta Isolated Conveyance Facility

South Delta Canal Typical Canal Section

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